MultiFRAD™ 200-Series

Router/Two-Port Frame Relay Access Device with 56K DSU

MultiFRAD 200-Series

Models FR221 & FR221/V2

User Guide

MultiTech® Systems

User Guide

88311950 Revision A

MultiFRAD (Models FR221 and FR221/V2)

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MultiFRAD™ 200-Series

Router/Two-Port Frame Relay Access Device with 56K DSU

Chapter 1 - Introduction and Description

MultiTech® Systems

Introduction

Welcome to Multi-Tech's new MultiFRAD™, Models FR221 and FR221/V2, Routers/ Two-Port Frame Relay Access Devices (FRADs). The “/V2” version includes a “Voice option” with two voice/fax channels (with three voice/fax interfaces on each voice channel). Both versions have a 10 Mbps Ethernet LAN interface, an internal DSU for the WAN interface, and a command port for configuration.

These MultiFRADs enable non-frame relay devices to connect to a common carrier frame relay network service or a private frame relay network. Multi-Tech’s new voice/fax gateway technology allows voice and fax communication to ride, with no additional expense, over your frame relay network, which has traditionally been data-only. To access this free voice and fax communication, all you have to do is connect the FR221/V2 to your telephone equipment and then to your frame relay connection. Once configured, the FR221/V2 allows voice and fax to travel down the same path as your traditional data communications.

Both of these MultiFRADs have two data ports for Data Terminal Equipment (DTE) devices that are either asynchronous or HDLC synchronous. The Ethernet LAN connection is provided for IP or IPX routing and Media Access Control (MAC) layer bridging for all other protocols on a 10Base-T port connection. These MultiFRADs also have an internal 56K DSU that can be connected directly to a frame relay network.

System management is provided through the command port using bundled Windows® based software which provides easy-to-use configuration menus.

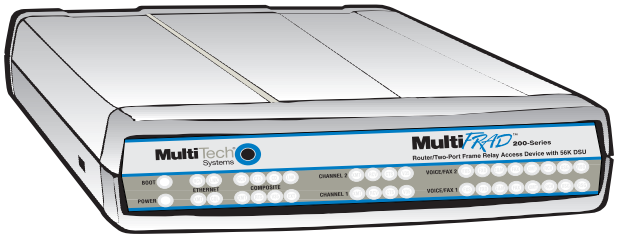


Figure 1-1. MultiFRAD 221/V2

Preview of this Guide

This User Guide describes the MultiFRAD and details how to install and configure it. The information contained in each chapter is as follows:

Chapter 1 - Introduction and Description

Chapter 1 describes the MultiFRAD and includes front panel descriptions, back panel connectors, and relevant technical specifications.

Chapter 2 - Installation

This chapter provides information on unpacking and cabling your MultiFRAD. Safety Warnings are detailed, followed by the installation procedure in which each cable is connected to the MultiFRAD and the unit is powered on.

Chapter 3 - Software Loading and Configuration

Chapter 3 details the software loading and configuration procedures. The MultiFRAD software is windows based; numerous configuration options are available and are described in this chapter.

Chapter 4 - MultiFRAD Software

Chapter 4 describes the MultiFRAD software package designed for the Windows® environment.

Chapter 5 - Remote Configuration and Management

Chapter 5 provides procedures for changing the configuration of a remote MultiFRAD. Remote configuration enables you to change the configuration of a unit by simply connecting a PC with communications software to a remote MultiFRAD that has communications software and a modem connected to the command port. You can then configure the unit. Chapter 5 also describes a typical Telnet Client configuration application and Web browser configuration.

Chapter 6 - Warranty, Service and Tech Support

Chapter 6 provides instructions on getting service for your MultiFRAD at the factory, a statement of the limited warranty, information about our user bulletin board service, and space for recording information about your MultiFRAD prior to calling Multi-Tech's Technical Support personnel.

Front Panel Description

The front panel of the FR221 has four groups of LEDs that provide the status of the LAN connection and the general status of the MultiFRAD. The FR221/V2 has an additional group of LEDs for its two voice/fax channels. From left to right, the first group of LEDs indicates whether the self test passed or failed and if the power On/Off switch on the back of the MultiFRAD is switched On. The Ethernet LEDs display LAN activity; i.e., they show whether the MultiFRAD is connected to the LAN, transmitting or receiving packets, and if a data collision is occurring. The Composite LEDs display the trunk (i.e., DSU) status, show whether a trunk is ready to transmit or receive serial data, and indicate if the trunk connection (i.e., the back panel TRUNK connector) is configured for a V.35 interface. The data Channel 1 and data Channel 2 LEDs display the status of the two data Channels, including whether the data Channel or the attached device is ready to transmit or receive data and if the data Channel is configured for a V.35 serial interface. Finally (on the FR221/V2 only), the voice/fax LEDs indicate the configuration and status of these two channels.

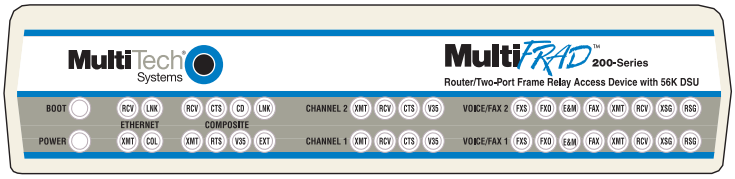


Figure 1-2. Front Panel

BOOT The **BOOT** indicator lights for 75 seconds (approx.) when power is applied to the MultiFRAD.

POWER The **POWER** indicator lights when the Power switch is set to the "1" (up, On) position.

ETHERNET

RCV **Receive** indicator blinks when packets are being received from the local area network.

LNK **Link** indicator lights indicating that the MultiFRAD is connected to the local area network.

XMT **Transmit** indicator blinks when packets are being transmitted to the local area network.

COL **Collision** indicator lights when a collision is in progress, that is, when two nodes are transmitting packets at the same time.

COMPOSITE (DSU, TRUNK)

RCV **Receive** indicator blinks when the trunk is receiving data.

CTS **Clear To Send** indicator lights when the trunk is ready to transmit data.

CD **Carrier Detect** indicator lights when the MultiFRAD detects a carrier signal on the trunk line.

LNK The composite **Link** LED blinks slowly when it detects the frame relay management type. Then, when at least one DLCI goes active, it blinks quickly. When all DLCIs are active, it remains on. In PPP mode, it remains on all the time.

XMT **Transmit** indicator blinks when the trunk is transmitting data.

RTS **Request to Send** indicator lights then the trunk is ready to receive data.

V35 The **V35** indicator lights whenever the trunk is configured for a V.35 interface; i.e., the shunt for the trunk is in the V.35 position.

EXT **External** indicator lights when the MultiFRAD is configured for an external composite device.

DATA CHANNELS

XMT **Transmit** indicator blinks when the Channel is transmitting data to the composite link.

RCV **Receive** indicator blinks when the Channel is receiving data from the composite link.

CTS **Clear To Send** indicator lights when the Channel is ready to transmit data.

XMT **Transmit** indicator blinks when voice packets are being transmitted to the local area network.

RCV **Receive** indicator blinks when voice packets are being received from the local area network.

V35 The **V35** indicator lights whenever the Channel is configured for a V.35 interface; i.e., the Channel shunt is in the V.35 position.

VOICE/FAX CHANNELS (FR221/V2 Only)

FXS **Foreign Exchange Station** indicator lights when the voice/fax Channel is configured for FXS operation.

FXO **Foreign Exchange Office** indicator lights when the voice/fax Channel is configured for FXO operation.

E&M **Ear and Mouth** indicator lights when the voice/fax Channel is configured for E&M operation.

FAX **Fax** indicator lights when there is fax traffic on the voice/fax Channel.

XMT **Transmit** indicator blinks when voice packets are being transmitted to the composite link.

RCV **Receive** indicator blinks when voice packets are being received from the composite link.

XSG **Transmit Signal** indicator lights when the FXS-configured Channel is off-hook, the FXO-configured Channel is receiving a ring from the PBX, or the M lead is active on the E&M-configured Channel (i.e., the MultiFRAD is receiving a ring from the PBX).

RSG **Receive Signal** indicator lights when the FXS-configured Channel is ringing, the FXO-configured Channel has taken the line off-hook, or the E lead is active on the E&M-configured Channel.

Back Panel Description

All the cable connections to the MultiFRAD are made at the back panel. Four categories of signal cables are used on the MultiFRAD: Ethernet, Channels, Command Port, and Trunk (RS232/V.35). The back panel connectors are shown in Figure 1-3 and described in the following groups.

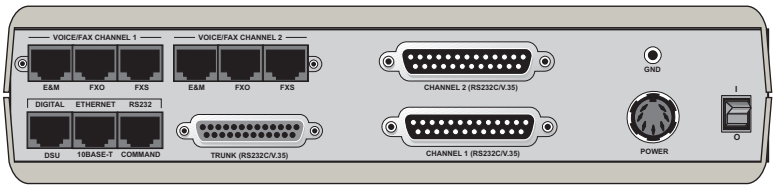


Figure 1-3. Back Panel (FR221/V2)

Voice/Fax Channel 1 and 2 (on FR221/V2 only)

The Voice/Fax Channel connectors include three options per Channel: E&M, FXO and FXS.

E&M - This connector is used if you are connecting VOICE/FAX CHANNEL 1 or 2 to the E&M trunk on a PBX. This connector is an RJ-48 jack.

FXO - This connector is used if you are connecting VOICE/FAX CHANNEL 1 or 2 to the station side of a PBX. This connector is an RJ-45 jack.

FXS - This connector is used if you are connecting VOICE/FAX CHANNEL 1 or 2 to a station device, etc., an analog telephone, KTS telephone system, or fax machine. This connector is an RJ-45 jack.

Ethernet 10Base-T Connector

The Ethernet 10Base-T connector is used to connect the MultiFRAD to a LAN using unshielded twisted pair (UTP) cable. This connector is an RJ-45 jack.

DSU Connector

The DSU connector is used to connect the MultiFRAD's internal DSU to a trunk connection of a frame relay network. The DSU connector is an RJ-45 jack.

Command Connector

The Command connector is used to configure the MultiFRAD using a PC with a serial port or terminal emulation. The Command connector has a DCE physical interface using an RJ-45 jack.

TRUNK Connector (Alternate)

The RS232/V.35 trunk connector can be used for diagnostic point-to-point testing of the MultiFRAD. This connector is a DB25 female connector.

Channels 1 and 2 Connectors

The two Channel connectors are used to connect data devices to the MultiFRAD. A data device can be a synchronous device such as a multiplexer or an asynchronous device such as a PC. The data Channels can be either RS232C or V.35 . If a V.35 connection is desired, then the internal shunt for that Channel must be physically moved from its default RS232 position to the V.35 position.

Power Connector

The Power connector is used to connect the external power supply to the MultiFRAD. The Power connector is a 7-pin circular DIN connector. A separate power cord connects the power supply to a live AC grounded outlet.

Shunts

There are three shunts (Figure 1-4) on the printed circuit board for the composite link trunk connection and the two data Channels.

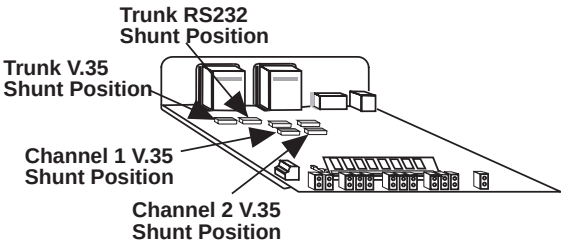


Figure 1-4. Shunts

Initially, all three shunts are installed in their default RS232 locations and the associated V.35 16-pin DIP sockets are empty. Each of the DIP sockets is identified by markings on the main PCB assembly. To change the position of a given shunt, refer to **V.35 Shunt Procedure** in Chapter 2.

Technical Specifications

The MultiFRAD conforms to the following specifications:

- Provides access to Frame Relay Networks for IP, IPX, bridged LAN traffic, Async and HDLC Sync devices
- DSU Port - 56 Kbps, synchronous
- Data ports can be configured as either EIA-232 or V.35
- Command Port - 19.2 Kbps, asynchronous

Data Ports

Supports 2 data ports with speeds of 300 bps to 115.2 Kbps asynchronous, and 4800 bps to 128 Kbps synchronous

- Asynchronous data format parameters: 5, 6, 7, 8 data bits; Even, Odd, None parity; 1, 1.5, 2 stop bits
- Async Data port options: local echo, hardware or software flow control, pacing, Xon pass-thru, ENQ/ACK spoofing
- Sync Channel parameters: internal/external clocking, flag or mark idle, NRZ/NRZI encoding, interframe timer
- Special APSM mode enables muxing of data port and LAN traffic over a single PVC

Ethernet Port

- Routing Protocols - IP and IPX and bridging all others
- Ethernet Interface - 10Base-T (twisted pair) RJ-45 connector
- Special APSM mode enables muxing of LAN traffic and data port data over a single PVC

Command Port

- Single 19.2K bps asynchronous Command Port with DB25 female connector.

DSU Port

- Provides 56 Kbps synchronous communication over DDS line.

Trunk Port

- Can be used with a 25-pin back-to-back cable for point-to-point diagnostic testing.

Electrical/Physical

- Power Supply Input: 100 to 250V AC ~ 50 to 60 HZ, 0.9A
- Power Supply Output: +5V DC @ 3.0A, +12V DC @ 0.5A, -12V DC @ 0.2A
- Power Consumption: 10 Watts
- Dimensions - 2.25" high x 9" wide x 12.875" deep
- Weight - 4.5 pounds (1.7 kg)

Requirement

- PC with one serial COM port to connect to the Command Port of the MultiFRAD for configuration

MultiFRAD™ 200-Series

Router/Two-Port Frame Relay Access Device with 56K DSU

Chapter 2 - Installation

MultiTech® Systems

Introduction

This chapter will guide you through the unpacking and installation of your MultiFRAD. The installation procedure, which is preceded by important safety warnings, provides step-by-step instructions on cabling and powering-on the MultiFRAD. Chapter 3 provides instructions on installing and configuring the MultiFRAD software.

Safety Warning Telecom

1. Never install phone wiring during a lightning storm.
2. Never install phone jacks in wet locations unless the jacks are specifically designed for wet locations.
3. This product is to be used with UL and cUL listed computers.
4. Never touch uninsulated phone wires or terminals unless the phone line has been disconnected at the network interface.
5. Use caution when installing or modifying phone lines.
6. Avoid using a phone (other than a cordless type) during an electrical storm. There may be a remote risk of electrical shock from lightning.
7. Do not use the phone to report a gas leak in the vicinity of the leak.
8. To reduce the risk of fire, use only No. 26 AWG or larger Telecommunication line Cord.

Lithium Battery Caution

Caution: Danger of explosion if battery is incorrectly replaced.

A lithium battery on the voice/fax channel board provides backup power for the time keeping capability. The battery has an estimated life expectancy of ten years.

When the battery starts to weaken, the date and time may be incorrect. If the battery fails, the voice/fax board must be sent back to Multi-Tech Systems for battery replacement.

Unpacking your MultiFRAD

Remove all items from the box. Your shipping box should contain the MultiFRAD, a power supply, various cables, software and manual disks, and a MultiFRAD Quick Start Guide. Inspect all items (Figure 2-1) before proceeding with the installation. If any item appears to be damaged, do not power up the unit; contact Multi-Tech's Technical Support personnel for advice (Refer to Chapter 6). If no damage is observed, configure the MultiFRAD using the information in the rest of this chapter.

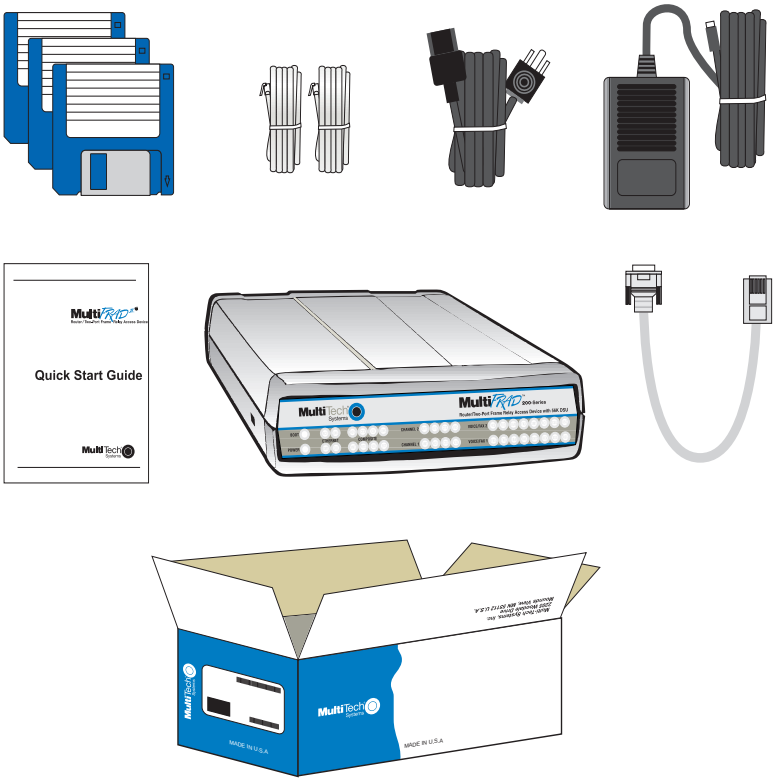


Figure 2-1. Unpacking the FR221/V2

Cabling your MultiFRAD

Cabling your MultiFRAD involves making the proper Power, Command Port, Ethernet, and Channel (and Voice/Fax, **FR221/V2 Only**) connections. Figure 2-2 shows the back panel connectors and the associated cable connections. The MultiFRAD supports two data channels.

Note: Before starting to cable your MultiFRAD (**FR221/V2 Only**), perform the E&M Jumper Block Positioning Procedure if either voice/fax channel (1 or 2) will be connected to an E&M trunk that is a Type 1,3,4, or 5 rather than a Type 2 (the default position).

The following steps detail the procedures for connecting the cables to your MultiFRAD.

1 Connect one end of a DB25 cable to each of the data channel connectors on the back of your MultiFRAD (labeled CHANNEL 1-2). See Figure 2-2. Connect the other end of each cable to a channel device.

Note: Both data channels support the RS232/V.35 protocols, and either asynchronous or HDLC synchronous RS232 data equipment such as multiplexers. Refer to V.35 Shunt procedure in Chapter 2 if it is necessary to switch from the default RS232 interface to V.35 interface.

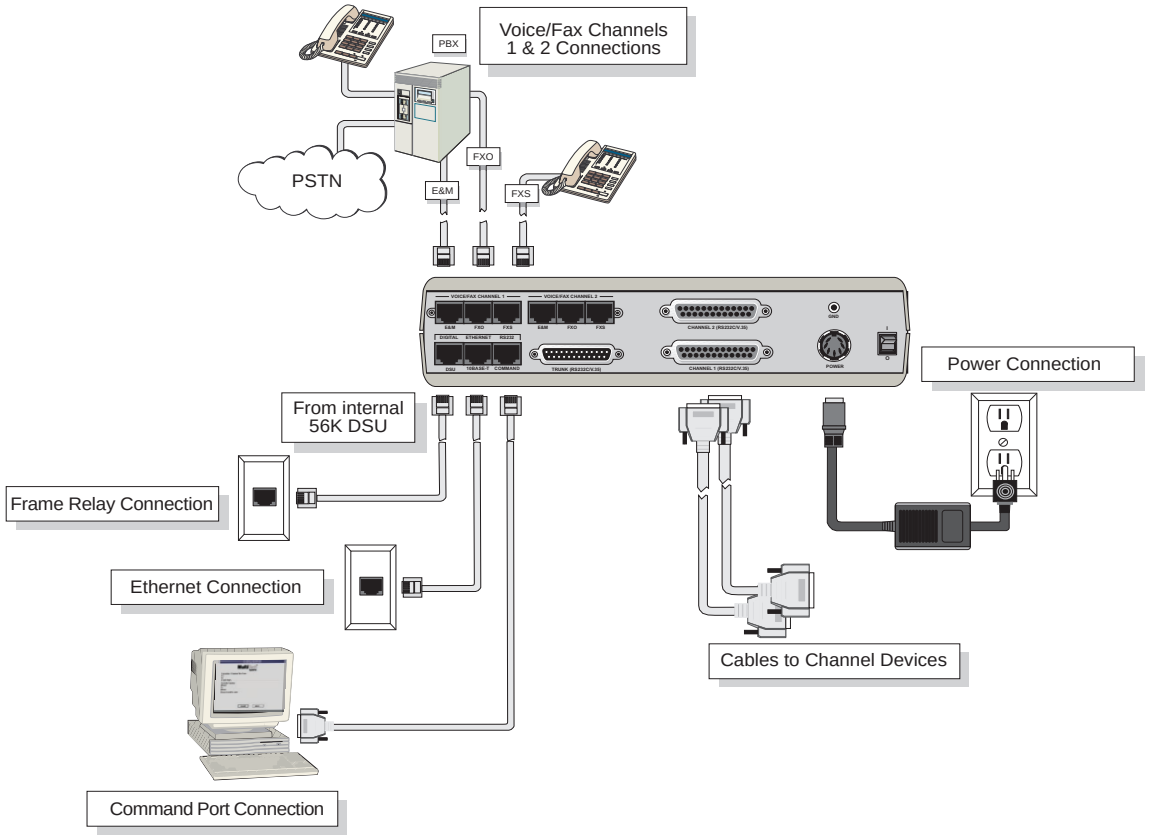


Figure 2-2. Cable Connections

2 Connect an RJ-45 Link cable from the DSU jack to a Trunk connection of a frame relay network.

3 Connect a network cable to the 10 BASE-T Ethernet connector (shown in Figure 2-2). Connect the other end of the cable to your LAN.

4 Connect the MultiFRAD to your PC using the short RJ-45 to DB9 (female) cable provided with your unit. Plug the RJ-45 end of the cable into the Command Port jack (labeled COMMAND) of the MultiFRAD and the other end into the serial port on the PC.

Note: The E&M, FXS, and Ethernet ports are not designed to be connected to a Public Telecommunication Network.

5 On the **FR221/V2 only**: if you are connecting your MultiFRAD to a station device; e.g., analog telephone, fax machine, or Key Telephone System (KTS); connect one of the supplied RJ-11 cables to the **Voice/Fax Channel 1 FXS** connector on the back of the MultiFRAD and the other end to the station device.

If you are connecting your MultiFRAD to a PBX extension, connect one of the supplied RJ-11 cables to the **Voice/Fax Channel 1 FXO** connector on the back of the MultiFRAD and the other end to the PBX extension

If you are connecting your MultiFRAD to an E&M trunk from a telephone switch, connect one end of an RJ-45 phone cord to the **Voice/Fax Channel 1 E&M** connector on the back of the MultiFRAD and the other end to the trunk. Note: Appendix a has a pinout diagram for the E&M back panel connector on the MultiFRAD.

6 Repeat the above step to connect the remaining telephone equipment to Voice/Fax Channel 2 on your MultiFRAD.

7 Connect the power supply to a live AC outlet, then connect the power supply to the MultiFRAD as shown in Figure 2-2. The Power connector is a 7-pin circular DIN connector.

At this time your MultiFRAD is completely cabled. Proceed to the section **Loading Your Software** to install your software.

V.35 Shunt Procedure

If you are using an external link device on a data port (or the trunk port), and the connection will be a V.35 connection, the corresponding internal shunt must be moved from its default RS232C position prior to cabling and power-up. The following steps detail the procedures for switching the shunt.

Step	Procedure
1	Ensure that the external power supply is disconnected from the MultiFRAD.
2	Turn the MultiFRAD upside down and remove the two cabinet mounting screws (Figure 2-3).

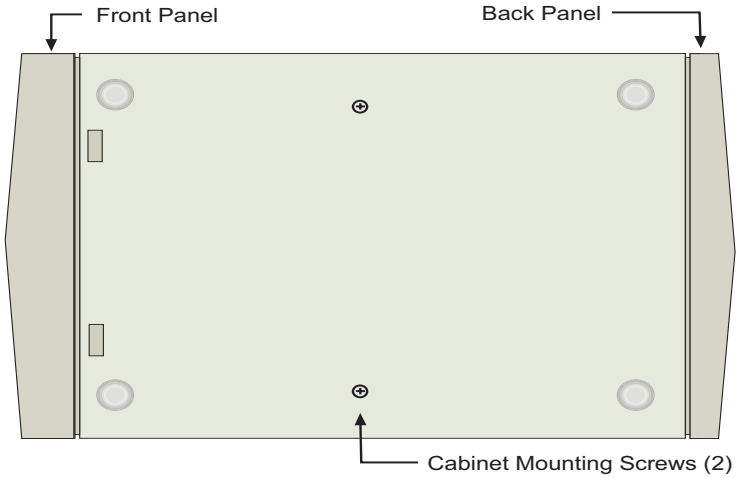


Figure 2-3. Cabinet Mounting Screw Locations

3 While supporting the back panel, turn the MultiFRAD right side up, then slide the PCB assembly out the back of the chassis.

4 Place the PCB assembly on a flat, grounded surface.

Note: For the FR221/V2 only, you will have to remove the voice/fax daughterboard by performing the following steps to gain access to the shunt locations on the main PCB assembly.

a. Remove four screws (Figure 2-4) that secure the daughterboard to the standoffs.

b. Grasp the corners of the daughterboard, then gently lift the front edge of the daughterboard upward, pivoting about the jacks at the back panel of the MultiFRAD, until the long pins are free of the mating connector on the main PCB assembly. Remove the daughterboard and set it temporarily aside.

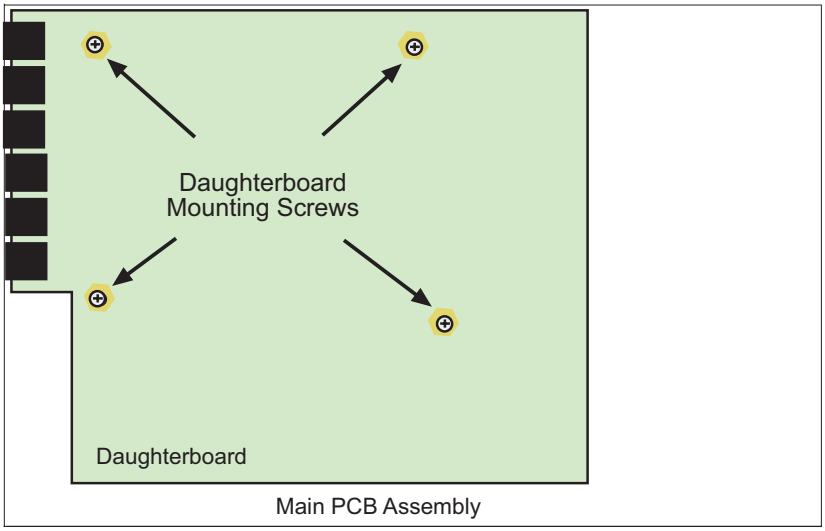


Figure 2-4. Daughterboard Mounting Screw Locations

5 Pry the shunt (TRUNK, CHANNEL 1, or CHANNEL 2) out of its default RS232 position; check that no pins are bent or missing, then insert the shunt in the corresponding V.35 position shown on Figure 2-5.

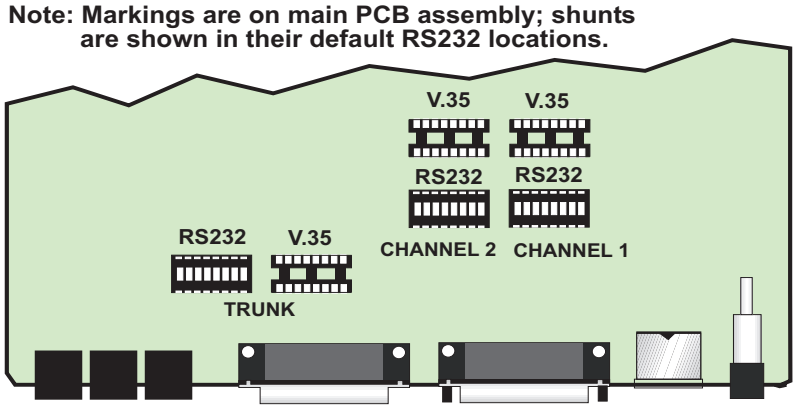


Figure 2-5. Shunt Positions

6 Repeat step 5 for any other shunt that needs to be moved.

Note: For the FR221/V2 only, reinstall the voice/fax daughterboard before replacing the PCB assembly in the cabinet. Check that none of the long pins are bent or out of alignment.

a. Holding the front corners of the daughterboard, gently ease the RJ-45 jacks into position at the back panel of the MultiFRAD, then carefully align all the long pins (on the underside of the daughterboard) with the mating connector on the main PCB assembly. When you are sure all the long pins are started in the mating connector, press down on the front edge of the daughterboard until the long pins are secure in the mating connector.

b. Reinstall the four screws (Figure 2-4) that secure the daughterboard to the standoffs.

7 Align the main PCB assembly with the guide slots on the inside of the chassis and carefully slide the board back into the chassis.

8 While supporting the back panel, turn the MultiFRAD over again, and replace the two cabinet mounting screws that were removed in step 2.

9 Turn the MultiFRAD right side up again, then return to **Cabling Your MultiFRAD**.

E&M Jumper Block Positioning Procedure (FR221/V2 Only)

Each voice/fax channel on the FR221/V2 has a separate E&M jumper block, located near the channel jacks on the back panel of the MultiFRAD. Each jumper block has 8 pairs of pins with a jumper plug on three adjacent pairs of pins. The E&M type numbers are labeled on the printed circuit board, and the jumper plug needs to be centered on the E&M type number corresponding to type of E&M connection used on that channel (1 or 2). Perform the following procedure if it is necessary to move the E&M jumper block from its default (Type 2) position.

1 Ensure that the external power supply is disconnected from the MultiFRAD.

2 Turn the MultiFRAD upside down and remove the two cabinet mounting screws midway back along both edges of the bottom of the cabinet.

3 Turn the MultiFRAD right side up, then slide the base out the rear of the cabinet.

Note: To change a jumper position, lift the jumper plug up off the jumper block, then move it to the new position, ensuring that the middle jumper of the jumper block is centered on the E&M type number (1,3; 4; or 5). See Figure 2-6.

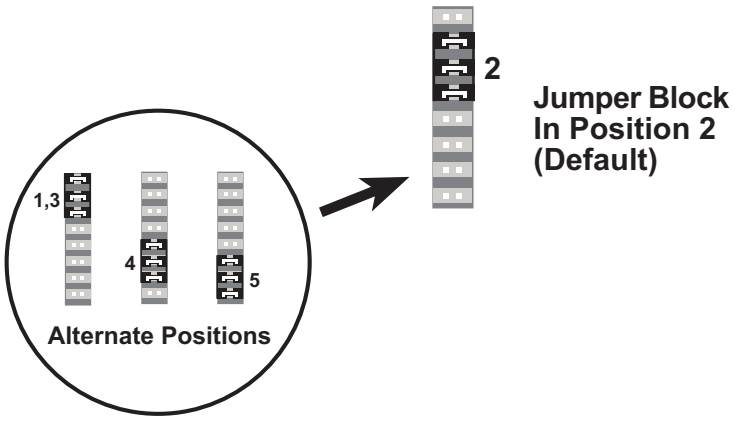


Figure 2-6. E&M Jumper Block Positions

4 Change the jumper block position for any voice/fax channel to be connected to an E&M trunk that is not a Type 2 (the default position).

5 Slide the base all the way into the cabinet until it stops.

6 Turn the MultiFRAD upside down and replace the two cabinet mounting screws that were removed in step 2.

7 Turn the MultiFRAD right side up, then return to **Cabling Your MultiFRAD** (FR221/V2 Only).

MultiFRAD™ 200-Series

Router/Two-Port Frame Relay Access Device with 56K DSU

Chapter 3 - Software Loading and Configuration

MultiTech® Systems

Installing Your Software

The following procedure does not provide every screen or option used in the process of installing the MultiFRAD software. The assumption is that a technical person with a thorough knowledge of Windows and the software loading process is doing the installation. Additional information on the MultiFRAD software is provided in the User Guide supplied with your MultiFRAD.

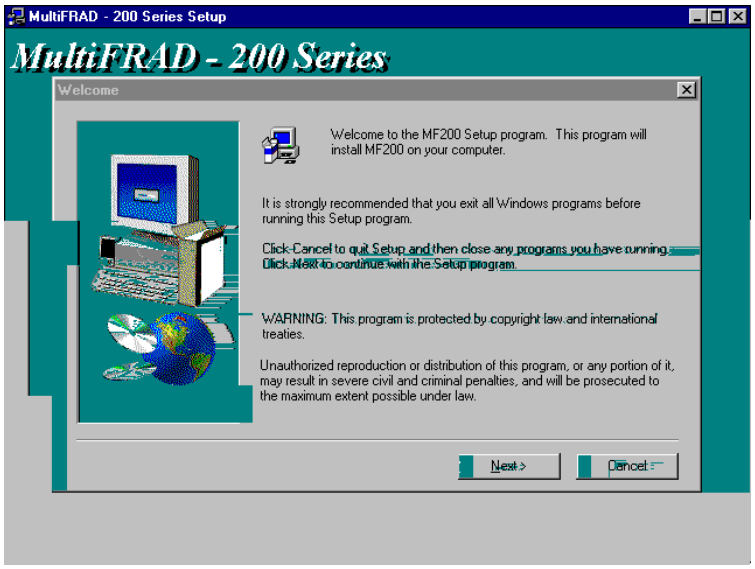
1 Run Windows on the PC that is connected to the Command Port.

2 Insert the MultiFRAD **Disk 1** into the disk drive on the PC that is connected to the Command Port.

3 **Win3.1 users** - in **Program Manager**, click **File | Run**. In the **Run** dialog box, type **a:\setup.exe** or **b:\setup.exe** (depending on the location of your floppy disk drive) in the **Command Line** field and then click **OK**.

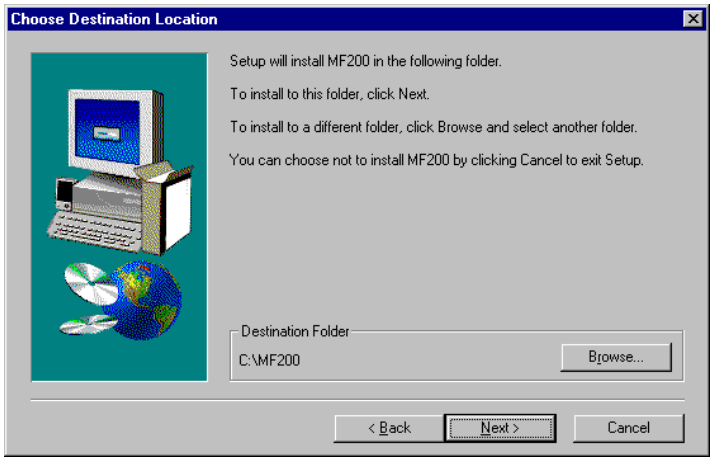
Win95/98/NT users - click **Start | Run**. In the **Run** dialog box, type (or click the down arrow and choose) **a:\setup** or **b:\setup** (depending on the letter of your floppy disk drive) and then click **OK**.

4 The **MultiFRAD 200 Series Setup** Welcome screen is displayed.


MultiFRAD - 200 Series Setup
MultiFRAD - 200 Series
Welcome
Welcome to the MF200 Setup program. This program will install MF200 on your computer.
It is strongly recommended that you exit all Windows programs before running this Setup program.
Click Cancel to quit Setup and then close any programs you have running. Click Next to continue with the Setup program.
WARNING: This program is protected by copyright law and international treaties.
Unauthorized reproduction or distribution of this program, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under law.
Next >
Cancel

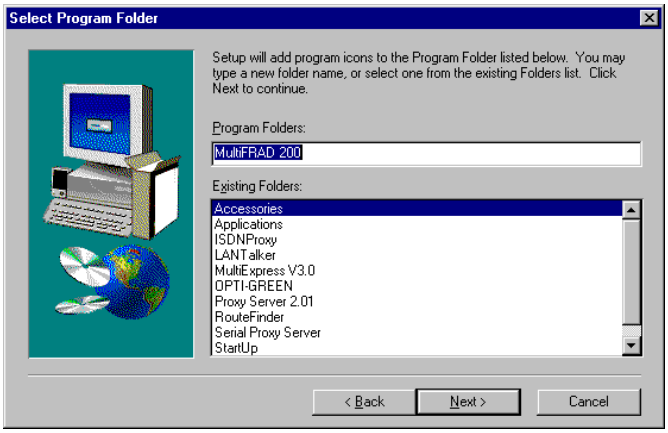
Click **Next>** to continue.

5 Follow the on-screen instructions to install your MultiFRAD software.

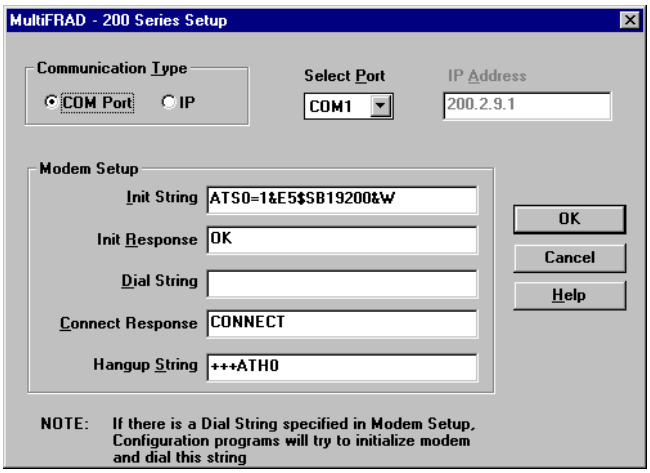

Choose Destination Location
Setup will install MF200 in the following folder.
To install to this folder, click Next.
To install to a different folder, click Browse and select another folder.
You can choose not to install MF200 by clicking Cancel to exit Setup.
Destination Folder
C:\MF200
Browse...
< Back
Next >
Cancel

You can choose the Destination Location of your MF200 software or you can accept the default destination by clicking **Next>**. If you click **Browse**, you can select a different folder for your MultiFRAD software; however, it is recommended that you accept the default folder, **MF200**.

6 The next dialog box enables you to name the Program Folder for the MF200 files. You can select the default name, **MultiFRAD 200**, or name it anything you like; when done, click **Next>** to continue.

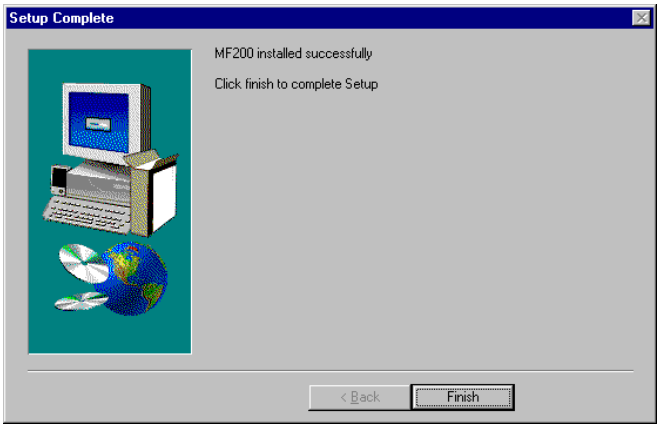


7 After all the program files from both disks are loaded, the **Setup** dialog box is displayed, enabling you to designate the COM port of the PC that is connected to your MultiFRAD. On the **Select Port** field, click the down arrow and choose the COM port of your PC (COM1 -- COM4) that is connected to your MultiFRAD.



Click **OK** to continue.

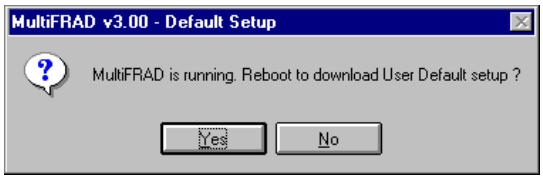
8 The **Setup Complete** screen is displayed. Click **Finish** to continue.



9 The following message is displayed:

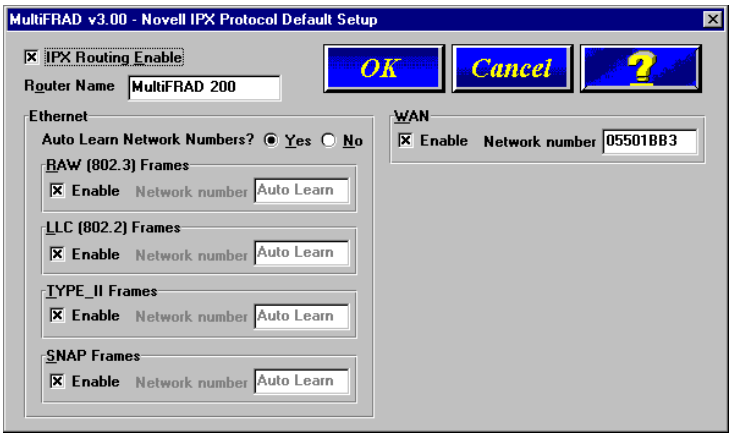
Click **Yes** to continue.

10 If your MultiFRAD is already turned on and fully booted, you may get the following message; if so, click **Yes** to continue.



Ethernet Setup

11 If your MultiFRAD is connected to an IPX network, continue with the following steps (12 thru 15). If your MultiFRAD is NOT connected to a LAN, click the **IPX Routing Enable** check box to disable IPX, then click **OK** and proceed to step 16 to disable IP protocol.



12 **Router Name:** You can either use the default Router Name (MultiFRAD 200) or assign a new Router Name in this field. The Router Name must be a unique printable ASCII string of a maximum of 47 characters.

13 **Ethernet:** You can enable Auto Learn Network Numbers by leaving the default **Yes** or you can click **No** (each Network number field will then become active) and manually assign the network numbers here.

If no file server is connected to the Ethernet segment, then this field should be **No**.

If you enable Auto Learn (**Yes**), the MultiFRAD will learn the IPX network numbers from the file server.

If you select **No** for Auto Learn, record the network numbers assigned by the network file server for each of the four frame types [Raw (802.3), LLC (802.2), EthernetII (Type II), SNAP] in the spaces provided below.

RAW (802.3) Frames Network Number _____
LCC (802.2) Frames Network Number _____
TYPE_II Frames Network Number _____
SNAP Frames Network Number _____
WAN Network Number _____

When you manually assign network numbers, make sure they match the network numbers assigned to your local file server (if any).

14 **WAN**: Enter the WAN network number for the Frame Relay WAN Port by clicking the Network Number box, backspacing through the default number, and entering your new WAN Number. Make sure the WAN network number is the same as the MultiFRAD on the other end of the link.

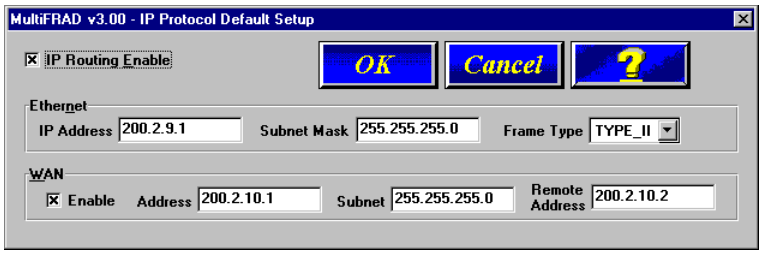
The WAN network number has to be assigned by the Network Administrator and must be unique throughout the entire internetwork.

Note: The WAN port does not have the capability of learning the network number, unlike the LAN port (i.e., the WAN port does not have a file server).

15 Click **OK** when you are satisfied with your selections.

16 If your MultiFRAD is connected to an IP network, continue with the following steps (17 thru 22).

If your MultiFRAD is NOT connected to a LAN or the network does not use IP, click the **IP Routing Enable** check box to disable the IP protocol, then click **OK** and proceed to step 23.



17 Record the IP address protocol information for your specific network in the space provided below:

Ethernet		
IP Address ___.___.___.___	Mask ___.___.___.___	Frame Type TYPE II/SNAP
WAN Port		
IP Address ___.___.___.___	Mask ___.___.___.___	Remote Address ___.___.___.___

18 The default Ethernet IP Address has to be changed to your unique LAN address. Enter an acceptable, unique **IP address** for the Ethernet port.

19 Change the default **Subnet Mask** and **Frame Type** to the values you have assigned to your LAN port.

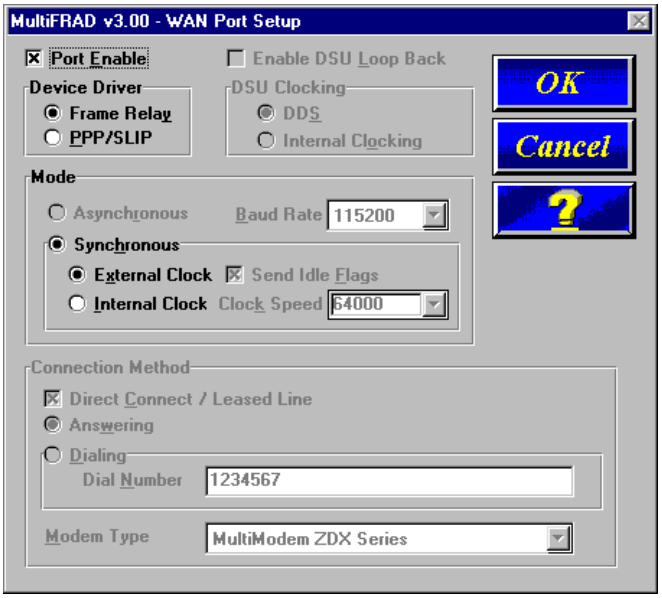
20 The default WAN Address has to be changed to your unique WAN address. Assign an acceptable unique **WAN Address** to the WAN port.

21 Change the default **Subnet Mask** and **Remote Address** for WAN to the values you have assigned to your WAN.

22 Click **OK** when you are satisfied with your selections.

WAN Port Setup

23 The **WAN Port Setup** dialog box is displayed.



The defaults are as shown above: Frame Relay connection, Synchronous mode, with external clocking (DDS) from the phone system.

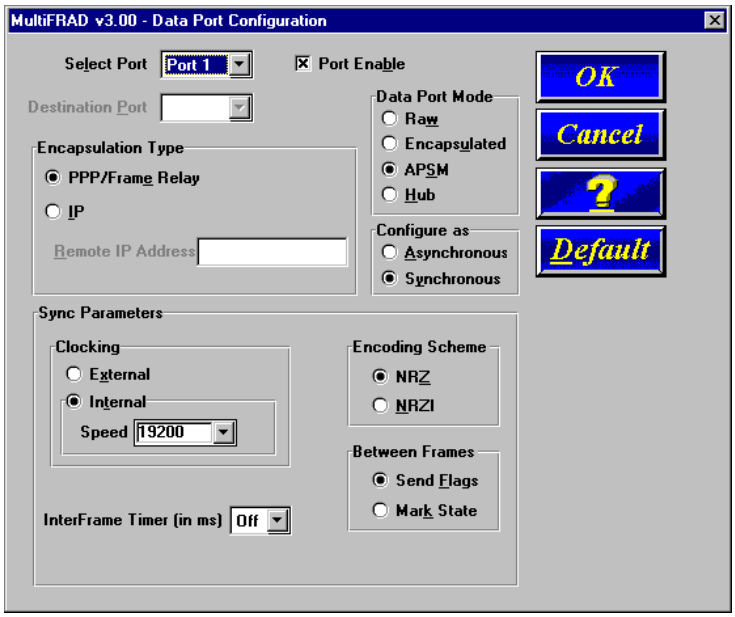
Since the DSU connector on your MultiFRAD is cabled to a trunk connection of a frame relay network, click **OK**.

Data Ports Setup

24 The **Data Port Configuration** dialog box enables you to individually configure the two data channels (Port 1 and Port 2) for PPP/Frame Relay, data over IP, or as a frame relay Hub. The **Encapsulation Type** group determines how the data channel is configured.

If your MultiFRAD will be connected to a frame relay network or point-to-point, then accept the default **PPP/Frame Relay** option in the **Encapsulation Type** group. However, if you are configuring your MultiFRAD for data over IP, then select the **IP** option. The **Remote IP Address** field becomes active; enter the IP address of the remote MultiFRAD.

The **Point-to-Point Protocol (PPP)** is used to connect a pair of MultiFRADs together without going across a frame relay network.



25 If your Multifrad will be connected to a Frame Relay network (but not to an Ethernet LAN) and both data channels are synchronous and are being mapped to individual DLCIs, use the **Raw** option.

Select the **Encapsulated** option when a synchronous data channel and LAN traffic are combined on a single frame relay DLCI.

Use the **Hub** option to route DLCIs to other MultiFRADs that are connected to the Data Ports. The Hub function can be used to add data channels or to set up an Internet connection through a router connected to one of the data channel ports.

If your MultiFRAD is going to be connected in a Point-to-Point configuration, **Data Port Mode** defaults to **APSM** and all other modes are disabled.

26 If your data device is a synchronous device, ensure that the clocking is correct, and set the Speed if an internal clock is used. Also check that the Encoding Scheme, Between Frames, and InterFrame Timer settings are correct for your channel device, per user documentation.

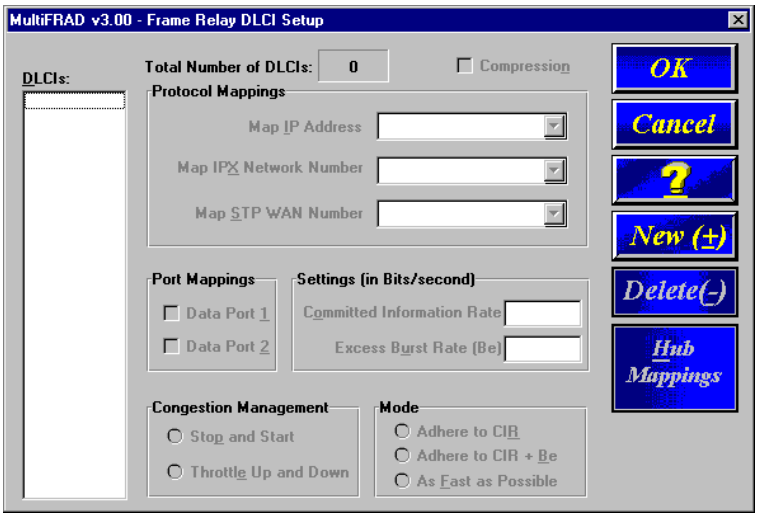
If your data device is an asynchronous device, click **Asynchronous**, then set the **Speed** in the drop-down list. Also select the Word Length, Parity, Stop Bits, etc. for your device. Refer to the user documentation for the parameters of the data device.

27 Click **OK** when you are satisfied with the configurations for both data ports. If you enabled PPP in the WAN Ports Default Setup dialog box, proceed to step 30.

DLCI Setup

28 If you enabled Frame Relay in the WAN Ports Default Setup dialog box, the **Frame Relay DLCI Default Setup** dialog box is displayed with all the groups inactive. Click **OK** to continue.

Note: When your MultiFRAD is connected to an active frame relay network service, it can detect DLCIs and the frame relay management type. However, at this point your MultiFRAD is not yet communicating with the frame relay network. We recommend that you finish loading the software and then access the frame relay dialog box from the main menu.



Voice/Fax Channel Setup

29 The **Voice/Fax Channel setup** dialog box is displayed. Its three tabs are used to define the voice/fax channel interface, voice coder, fax parameters, and regional phone parameters (tone pairs) for each channel.

Configure each channel for the type of interface you are connecting to. The Interface tab defaults to **Channel 1** in the **Select Channel** field.

30 The **Interface** group defaults to **FXS (Loop Start)**. Select the interface option that corresponds to the interface type being connected to the Voice/Fax connector on the back panel of the MultiFRAD.

If you are connecting a station device; e.g., an analog telephone, fax machine, or KTS telephone system to the Voice/Fax connector on the back of the unit, **FXS (Loop Start)** will likely be the correct Interface option.

If the station device uses ground start, then choose the **FXS (Ground Start)** option. Refer to the device's user documentation.

If you are using an analog extension from your PBX, then choose the **FXO** option. Check with your in-house phone personnel to verify connection type.

If you are connecting to an analog trunk on your PBX, then choose the **E&M** option.

If you choose the **FXO** interface, the Dialing Options Regeneration group is enabled. Check with your local in-house phone personnel to verify whether your local PBX dial signaling is **Pulse** or tone (**DTMF**). Then, set the Regeneration option accordingly.

If you choose the **E&M** interface, then the E&M Options group is enabled. Check with your local in-house phone personnel to determine if the signaling is **Dial Tone** or **Wink** and if the connection is 2-wire or 4-wire. If Wink signaling is used, then the **Wink Timer** is enabled with a default of 250 milliseconds. The range of the Wink Timer is from 100 to 350 milliseconds. Consult with your local in-house phone personnel for this timer setting.

If you want to dedicate a local voice/fax channel to a remote voice/fax channel (so you will not have to dial the remote channel), click the **Auto Call Enable** option in the **Auto Call** group. Then enter the appropriate DLCI in the **DLCI Number** field. Change the **Channel** number to the channel of the remote MultiFRAD you want to call.

If you enable the Auto Call feature, this channel will not have to be entered in the Phone Directory Database; you will have a direct line whenever you pick up the receiver.

Note: After configuring a given channel (1 or 2), you can copy that channel's configuration to the other channel by selecting the other channel in the "Duplicate To" group and clicking the **Copy** button. Everything on the **Interface** tab will be copied to the other channel.

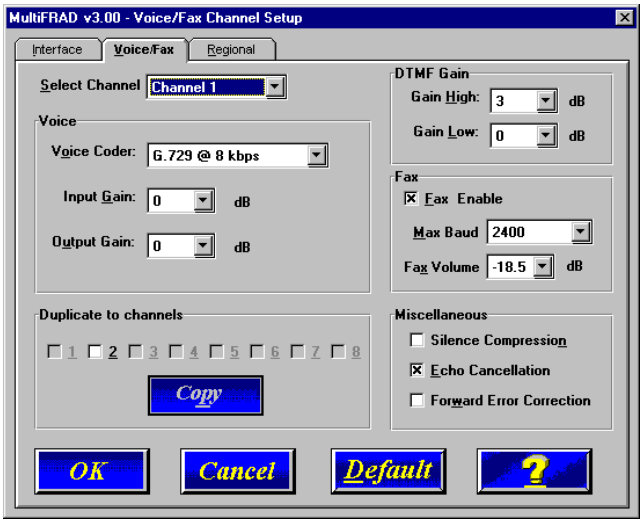
31 Repeat the above step to configure the interface type for voice/fax channel 2. To change the channel number, click the down arrow and highlight **Channel 2**.

32 When you are satisfied with your interface choices, and if the default voice coder is acceptable and your country/region is the default USA, then you can click **OK** and continue building your phone directory database.

If you need to change the voice coder, click the **Voice/Fax** tab and proceed to step 34.

If your country/region is not the default USA, then click on the **Regional** tab and proceed to step 35.

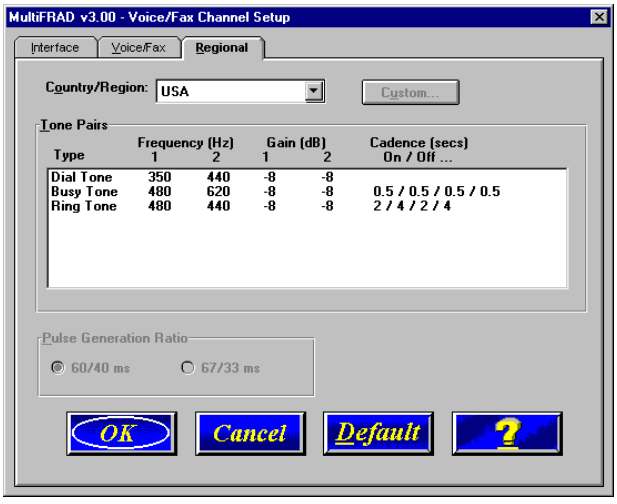
33 To change the voice coder, first select the channel by clicking the **Select Channel** down arrow and highlighting the channel number, then click the **Voice Coder** down arrow and highlight your new voice coder entry.



If you change the voice coder, ensure that the same voice coder is used on the voice/fax channel you are calling; otherwise, you will always get a busy signal.

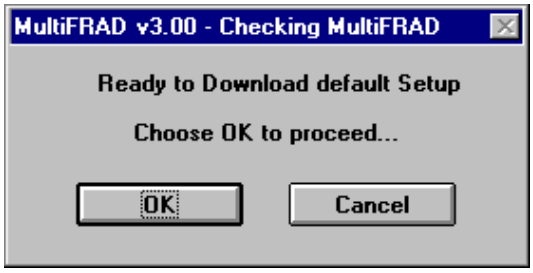
Note: After configuring a given channel (1, or 2), you can copy that channel's configuration to the other channel by selecting the other channel in the "Duplicate To" group and clicking the **Copy** button. Everything on the **Voice/Fax** tab will be copied to the other channel.

34 To change the Tone Pairs, click the **Regional** tab and then click the **Country/Region** down arrow and highlight your specific country or region.



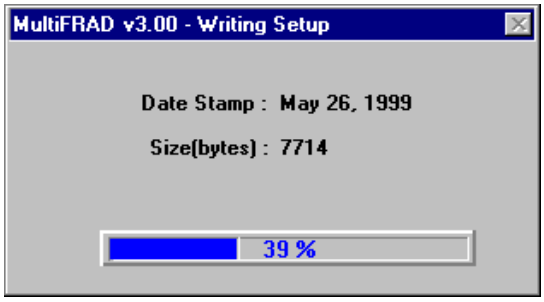
The Tone Pairs parameters change per your choice. Click **OK** when finished.

35 The **Checking MultiFRAD** dialog box will appear.

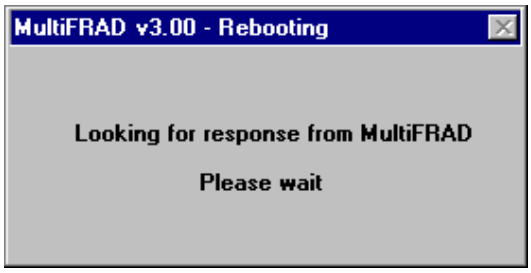


Click **OK** to continue.

36 The **Writing Setup** dialog box is displayed as the setup configuration is written to the MultiFRAD.



37 After the setup is written to the MultiFRAD, the unit reboots.



38 Check that the **BOOT** LED on the MultiFRAD is Off after the download is complete. This may take several minutes as the MultiFRAD reboots.

39 **Win3.1 users** - you are returned to your Program Manager where the MultiFRAD 200 Program Group and Program Item (Windows icons) have been created.

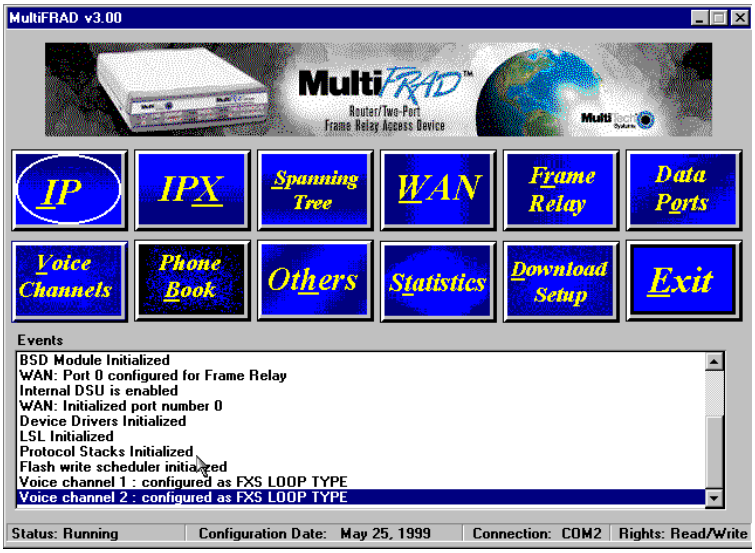
Win95/98/NT users - you are returned to your MultiFRAD 200 folder which will be visible on your desktop.

Detect and Map Your DLCIs

40 To detect DLCIs and map your data ports and protocols to the detected DLCIs, perform the following steps:

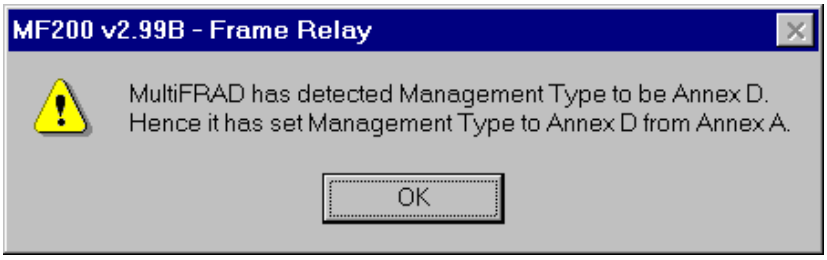
Win3.1 users - from the Program Manager, click the **MultiFRAD Configuration** icon in the MultiFRAD 200 Program Group. The main menu is displayed.

Win95/98/NT users - from your desktop, click **Programs | MultiFRAD 200 | MultiFRAD Configuration**. The main menu is displayed.



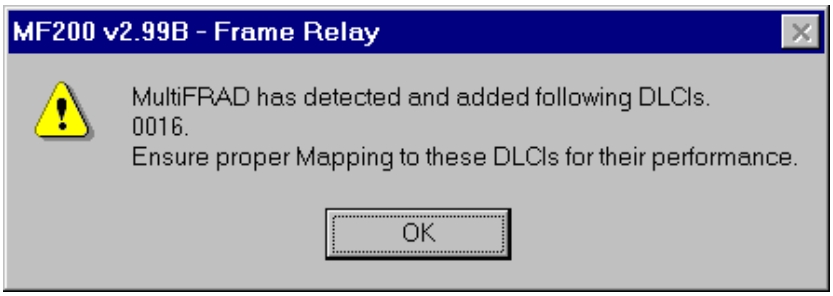
Click **Frame Relay**.

41 A **Frame Relay** dialog box is displayed, stating “MultiFRAD has detected Management Type to be Annex D. Hence it has set Management type to Annex D from Annex A.” The Management Types are Annex A, Annex D, or LMI. Any one of them could appear in this dialog box.

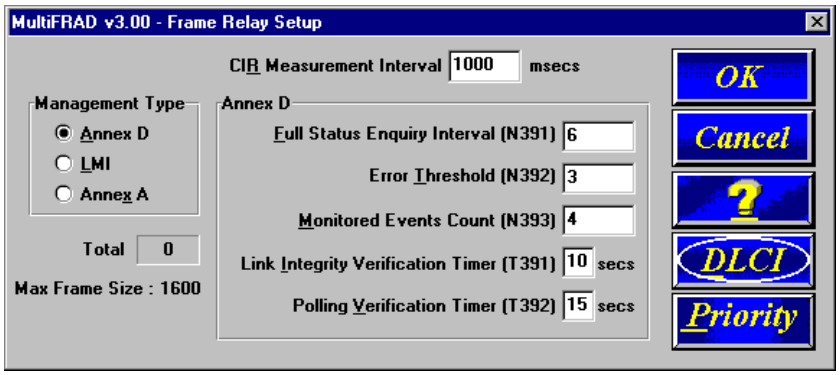

MF200 v2.99B - Frame Relay
MultiFRAD has detected Management Type to be Annex D.
Hence it has set Management Type to Annex D from Annex A.
OK

Click **OK**.

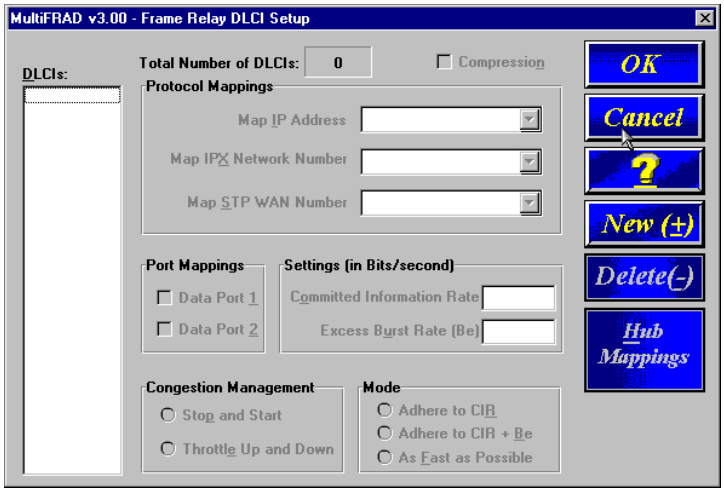
42 A **second Frame Relay** dialog box stating “MultiFRAD has detected and added the following DLCIs.” is displayed.


MF200 v2.99B - Frame Relay
MultiFRAD has detected and added following DLCIs.
0016.
Ensure proper Mapping to these DLCIs for their performance.
OK

Click **OK** and the **Frame Relay Setup** dialog box is displayed.



43 Click **DLCI** and the **Frame Relay DLCI Setup** dialog box is displayed.



The **Compression** option may be useful at low link speeds (i.e., below 56K); however, do not use this feature with a high speed link (i.e., 56K or higher). Click to enable this option for each DLCI on which you want to use the compression function.

44 Click the DLCI you want to map. The Protocol Mappings, Port Mappings, and all the other groups become active. To map the network protocol to the selected DLCI, click the down arrow for the active protocol **(Map IP Address, Map IPX Network Number,** or **Map STP WAN Number)** and select the IP address, IPX network number, or STP WAN number you want to use.

45 To map a data port to this DLCI, click (to enable) the Data Port (Data Port 1 or Data Port 2 in the Port Mappings group) that you want to associate with this DLCI.

46 Click the **Committed Information Rate** text box in the **Settings (in Bits/second)** group and enter the CIR value your service provider supplied for this DLCI.

47 Click the **Excess Burst Rate (Be)** text box in the **Settings (in Bits/second)** group and enter the Be value your service provider supplied for this DLCI.

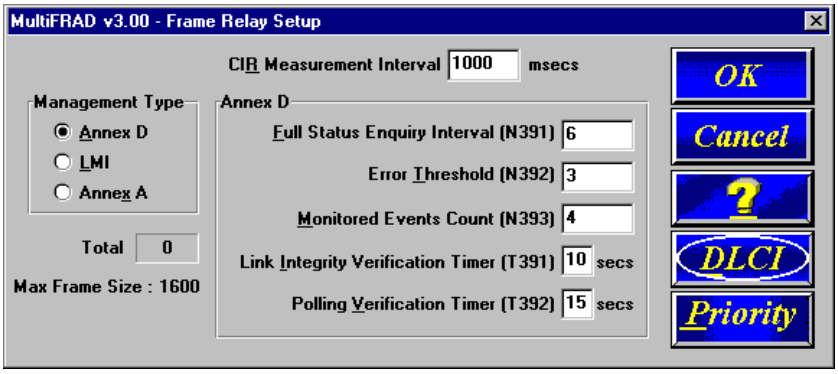
48 Ensure that **Throttle Up and Down** is selected in the **Congestion Management** group.

49 Ensure that **Adhere to CIR + Be** is selected in the **Mode** group. Multi-Tech recommends using this setting initially.

50 Repeat steps 44 through 49 for each new DLCI.

51 Click **OK** when you are satisfied with all your selections.

52 The **Frame Relay Setup** dialog box is displayed.



Click **OK**.

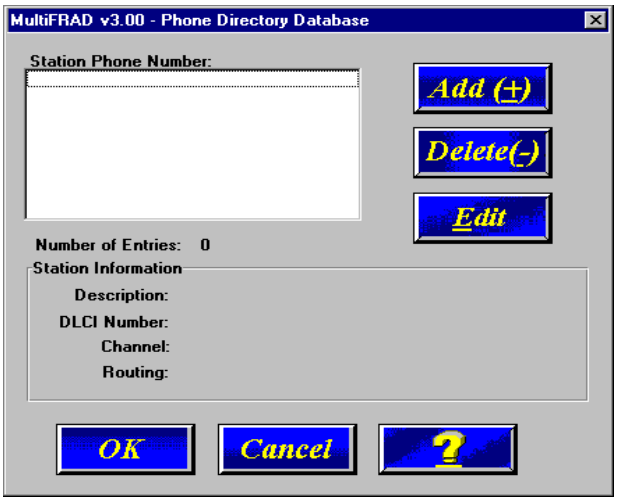
53 The main menu is displayed.

Build Your Phone Directory Database

Perform the following steps to construct your phone directory database.

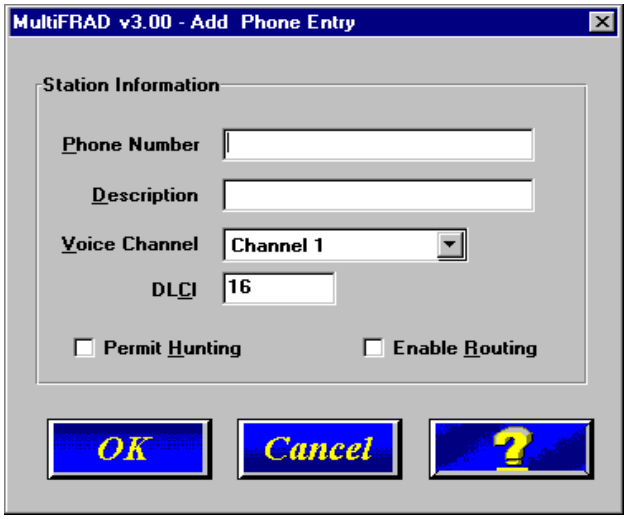
54 Click **Phone Book** on the main menu. The **Phone Directory Database** dialog box is displayed. You will build your personalized MultiFRAD Phone Directory in the following steps.

The completed database will contain the phone numbers, associated descriptions, DLCI numbers, and channels for all the MultiFRADs available for communication on the internetwork.



The Add (+) button is active, enabling you to start building the phone directory database that will control the calls.

55 Click **Add (+)** to begin building your phone directory database. The **Add/Edit Phone Entry** dialog box is displayed.



In the **Station Information** group, enter a unique phone number for the destination voice/fax channel in the Phone Number field. For example, phone number 101. (This number does not have to be a standard number with 7 or more digits.)

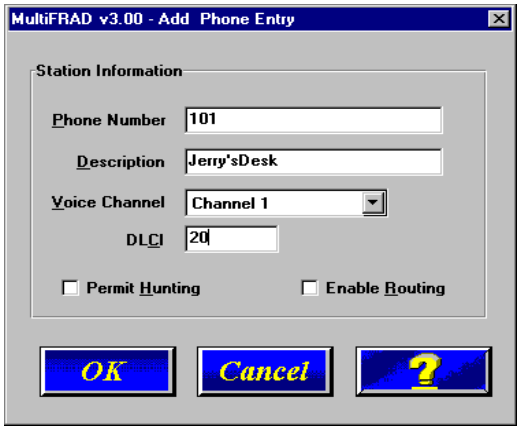
The **Description** field for the phone number is optional. In the following example, we describe this phone number as, “Jerry’s Desk.”

The **Voice Channel** field defaults to Channel 1. To change the channel number, click the down arrow and highlight the desired channel.

The DLCI field defaults to the number 16, which can be changed by selecting it and typing the desired number. (We are using DLCI number 20 in this example.)

The **Permit Hunting** option enables your call to connect to any open channel on the remote unit if the first channel is busy. Click to enable **Permit Hunting** if you want this function to be active.

If there is no direct PVC between the local MultiFRAD and the MultiFRAD that this phone number dials, you will need to click to check **Enable Routing** to assure that such calls will be routed through the central site’s voice/fax MultiFRAD to the appropriate remote MultiFRAD.



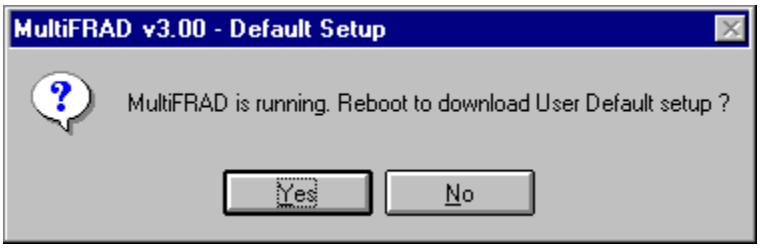
56 Click **OK** and you are returned to the **Phone Directory Database** dialog box, which now displays the phone number 101 in the **Station Phone Number** list and your other information in the **Station Information** group.

57 Repeat steps 55 and 56 for each additional phone number. You should enter one phone number for each remote channel that you want to call. When you are finished, click **OK**.

58 You are returned to the main menu.

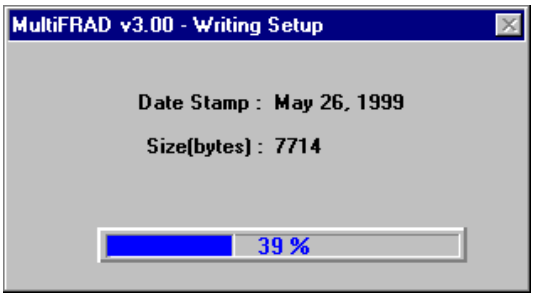
Click **Download Setup**.

59 The “Save Current Setup” dialog box is displayed.

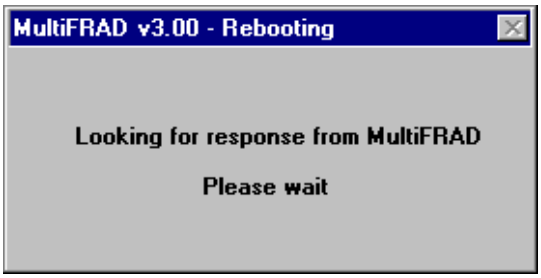


Click the check box to retain the current setup as the User Default Configuration, then click **OK**.

60 The **Writing Setup** dialog box is displayed as the setup configuration is written to the MultiFRAD.



61 After the setup is written to the MultiFRAD, the unit reboots.



62 Check that the **BOOT** LED on the MultiFRAD is Off after the download is complete. This may take several minutes as the MultiFRAD reboots.

63 You are returned to the main menu.

Your MultiFRAD is operational at this time.

MultiFRAD™ 200-Series

Router/Two-Port Frame Relay Access Device with 56K DSU

Chapter 4 - MultiFRAD Software

MultiTech® Systems

Introduction

This chapter describes various features of the MultiFRAD software that enable you to change (update) the configuration of your MultiFRAD. The basic configuration parameters were established during the loading of the software (Chapter 3). The MultiFRAD software and configuration utilities described in this chapter enable you to change that initial configuration as necessary.

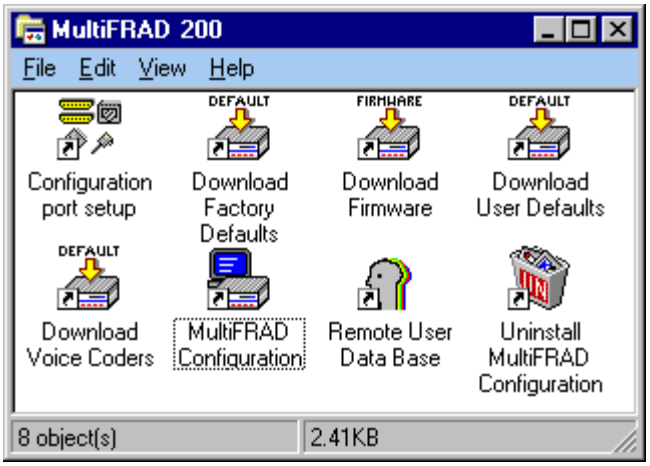
The primary interface to the MultiFRAD software is a main menu (with **MultiFRAD v3.00** in the title bar) with individual buttons that enable you to quickly and easily select a desired function. These features are discussed in detail in the MultiFRAD Configuration section later in this chapter.

The other seven configuration utilities in the MultiFRAD 200 software provide additional functionality. ***Download User Defaults*** enables you to download user defaults and update the MultiFRAD configuration with any necessary changes. ***Download Factory Defaults*** enables you to return the configuration to the original factory settings. ***Download Voice Coders*** enables you to download these software items to the MultiFRAD after repair or upgrade. ***Download Firmware*** enables you to download new versions of firmware as enhancements become available. The ***Configuration port setup*** utility enables you to change the method by which you access the MultiFRAD (i.e., through a direct connection of a PC to the Command Port on the MultiFRAD, or via your Internet or LAN connection to the LAN port on the MultiFRAD). The ***Remote User Data Base*** utility enables you to prepare a database of information concerning your remote users; you can add and remove users from the database or edit information already in the database. The ***Uninstall MultiFRAD Configuration*** utility removes the MF200 software from your PC.

The MultiFRAD software includes a context-sensitive Help system. Clicking a Help **[?]** button anywhere in the graphical user interface (GUI) will display definitions and recommended values for the buttons, options, and fields on that dialog box or menu. Clicking the green underlined text in the Helps displays a popup box of related supplementary information for that topic. Clicking the Search button (just below the menu bar) displays an Index tab with a list of numerous topics. Click a given topic, then click the Display button to display the text associated with that topic.

Before You Begin

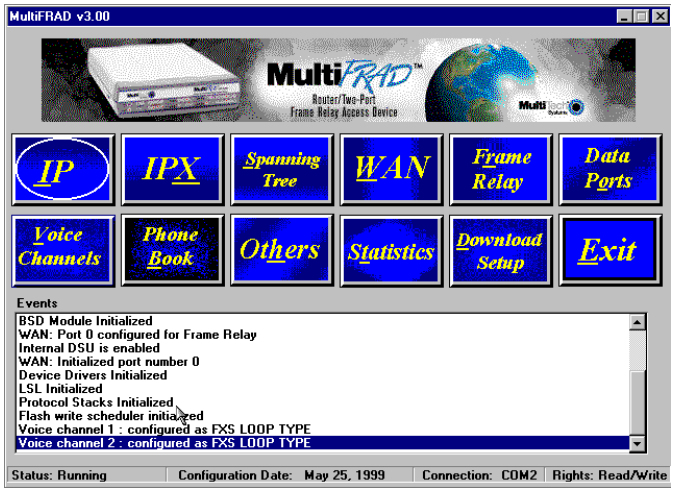
The MultiFRAD software operates in a Microsoft Windows® environment. The MultiFRAD 200 program group contains icons for all the utilities described above. In Windows 95/98/NT, you can access the individual utility programs either by clicking **Start | Programs | MultiFRAD 200 |** ***(utility)***, or by double-clicking the utility icon in the MultiFRAD 200 program group shown here:



MultiFRAD Configuration

To view or change your MultiFRAD configuration in Windows 95/NT, click **Start** | **Programs** | **MultiFRAD 200** | **MultiFRAD Configuration**, or double-click the MultiFRAD Configuration icon in the MultiFRAD 200 program group. After loading, the MultiFRAD main menu will appear.

The MultiFRAD main menu consists of 12 buttons in which you can point and click, an Events window, and a status bar. The 12 buttons enable you to display and change the protocol stacks, statistics, WAN port setup, Frame Relay parameters, data port configuration, enable applications such as SNMP Agent, Telnet Server, Web Server, and assign a MultiFRAD password.



The Events window can be a useful troubleshooting tool. Its purpose is to provide timely information about the boot process and ongoing information regarding the status of “events” such as the type of frame relay management selected and which PVCs are active.

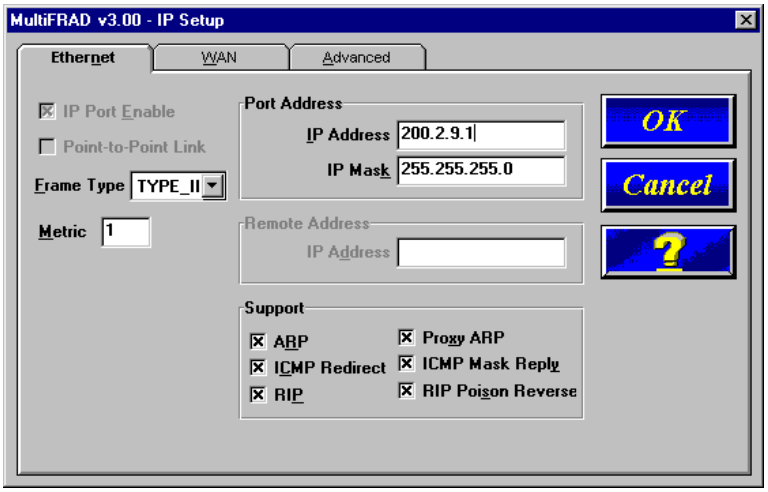
The status bar, located at the bottom of the main menu, displays MultiFRAD status (e.g.; Running), the date that the unit was configured, the type of connection on the command port; e.g., if the PC connected to the command port is using its serial port to communicate with the MultiFRAD or if the PC is communicating with the MultiFRAD via an Ethernet connection. The last field on the status bar is the Rights field which displays either Read/Write or Read only rights. The first user to connect with the MultiFRAD has Read/Write rights and can change the configuration of the MultiFRAD. The second user has read-only rights and can only *display* the configuration of the MultiFRAD.

If your WAN port (connected to the DCE device) is configured for frame relay, the button immediately to the right of the WAN button is entitled, “Frame Relay.” However, if your WAN port is configured for Point-to-Point operation, the marking on the button switches from “Frame Relay” to “PPP.”

Changing IP Parameters

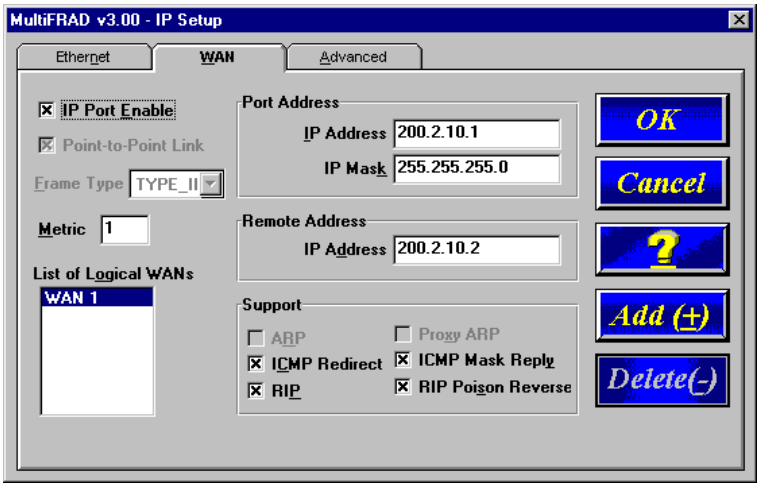
The IP Setup dialog box enables you change the IP routing capabilities, add or delete logical WANs, enable the DHCP relay agent, assign DNS server addresses, and define static routes and a default route. The initial routing capabilities were established during the software installation. You can change IP routing parameters by clicking on the Advanced tab and changing, for example, the RIP Response Time or RIP Route Aging Time. The WAN tab enables you to change the WAN port IP address, the remote address, and if logical WAN ports need to be added for frame relay, you can add them here by merely clicking the Add button.

The Ethernet IP Setup dialog box displays the parameters for your Ethernet port with the IP Address that was established during software installation.

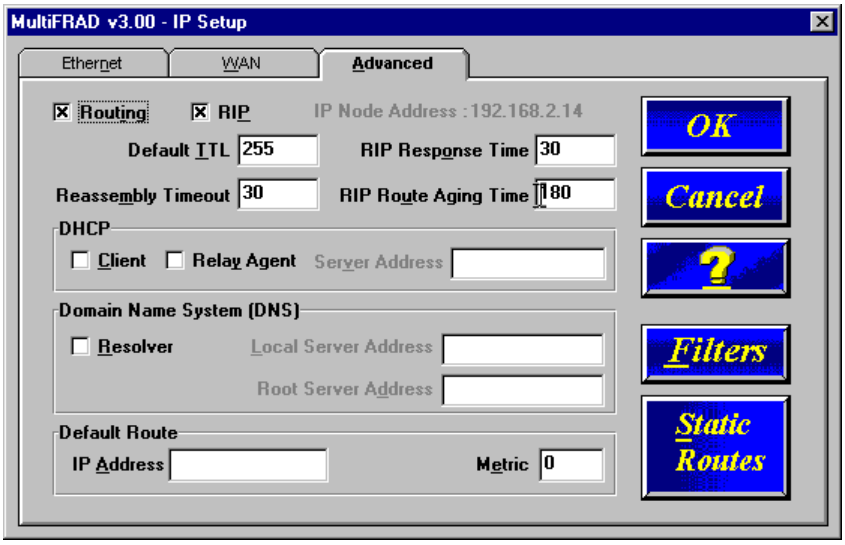


From the Ethernet IP Setup dialog box you can switch to the to either the WAN IP Setup dialog box or the Advanced IP Setup dialog box by clicking the respective tab.

The WAN IP Setup dialog box enables you to disable or enable IP routing on the WAN port, change the port IP Address, mask, or remote IP address. If the WAN port is configured for frame relay, this dialog box enables you to add logical WANs. General setup for the logical IP WAN ports is configured on the WAN Port Setup dialog box that opens when you click the WAN button on the main menu.



To add logical WAN in a frame relay configuration, click the Add(+) button and the next WAN number is displayed in the List of Logical WANs window in the lower left corner of the WAN IP Setup dialog box. To delete the last logical WAN assigned, click the Delete (-) button.

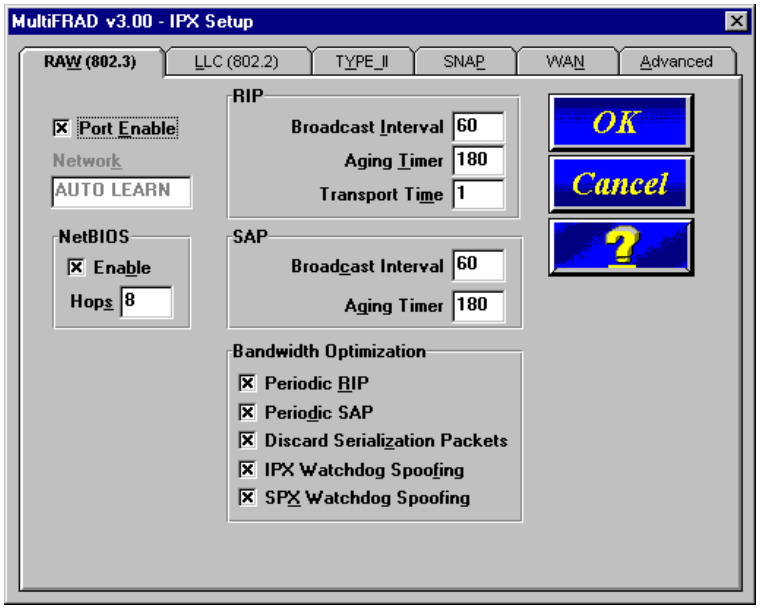


The Advanced tab on the IP Setup dialog box controls the timers, Dynamic Host Configuration Protocol (DHCP) and Domain Name System (DNS) options, the default route, filters, and Static Routes. In most cases, you should not have to change the value of any timer (default TTL, reassembly time-out, RIP response time, or RIP route aging time).

If you are using Default Routing, disable RIP based routing, then enter the IP host address of the “next hop.” The MultiFRAD will automatically use the IP route table to resolve the host address to a port number.

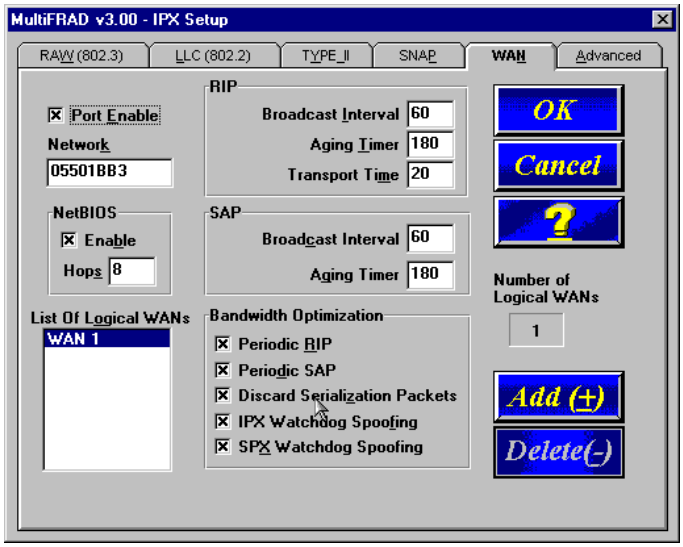
Changing IPX Parameters

The IPX Setup dialog box controls the four frame types and the WAN ports. The Advanced tab enables IPX routing, enables auto learn of Ethernet network numbers, and specifies the distributed name of the MultiFRAD.



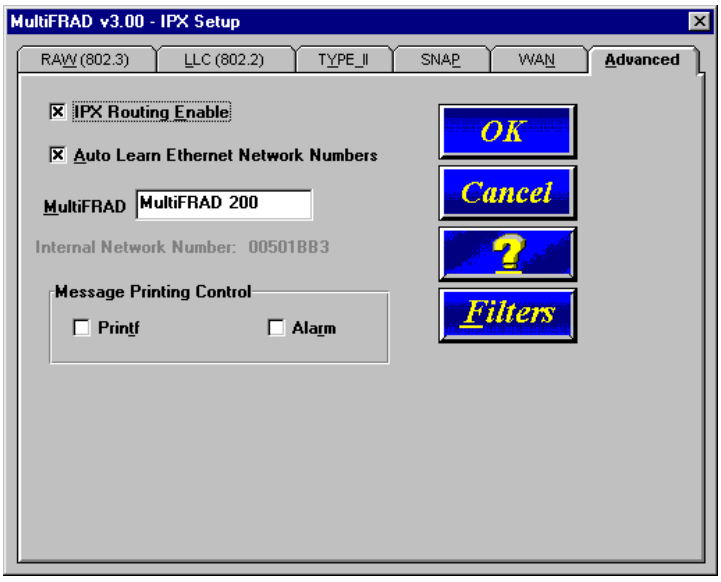
The RIP and SAP default timers should not have to be changed for most applications. Disabling IPX and SPX Watchdog Spoofing in the Bandwidth Optimization group has proven effective under certain circumstances with Citrix clients.

The WAN tab on the IPX Setup dialog box lets you to enable or disable IPX routing on the WAN port, change the network number for the WAN port, enable or disable NetBIOS, change the default RIP and SAP timers, and optimize the bandwidth. If the WAN port is configured for frame relay, this dialog box lets you to add logical WANs. How the WAN port is configured is controlled by the WAN Port Setup dialog box that you access by clicking the WAN button on the main menu.



The IPX WAN network number has to be the same on both ends of the link and must be unique throughout the internetwork. If the WAN port is configured in a point-to-point operation, both WAN network numbers have to be the same and unique. If the WAN port is configured for frame relay, both logical WAN network numbers have to be the same and unique. In a frame relay configuration, the logical WAN network number has to be the same and unique at both ends of the Permanent Virtual Circuit (PVC).

The Advanced tab on the IPX Setup dialog box controls the routing of the protocol, enables or disables auto learn of Ethernet network numbers, specifies the broadcast name of the MultiFRAD, and defines any IPX filtering by filter type, port number, and IPX address.

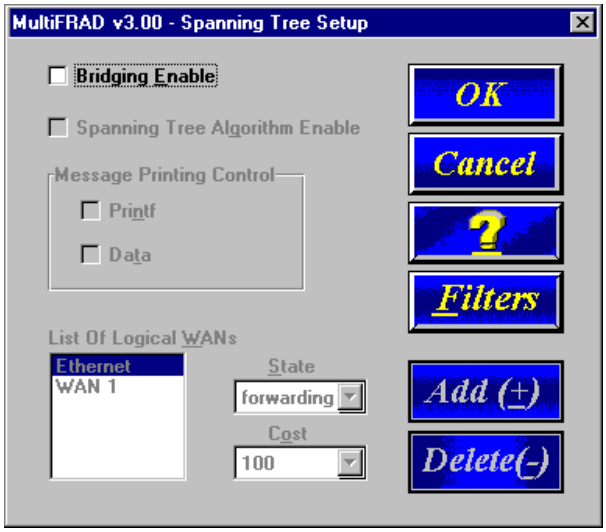


If bridging of IPX packets is desired, IPX routing must be disabled and frame type support for the frame type must be enabled.

If there is a server on the local segment, IPX network number auto learn should be enabled. If there is no server, or if for some reason the router comes up before the server, the router will default to some random network numbers after a short interval of time.

Spanning Tree Setup

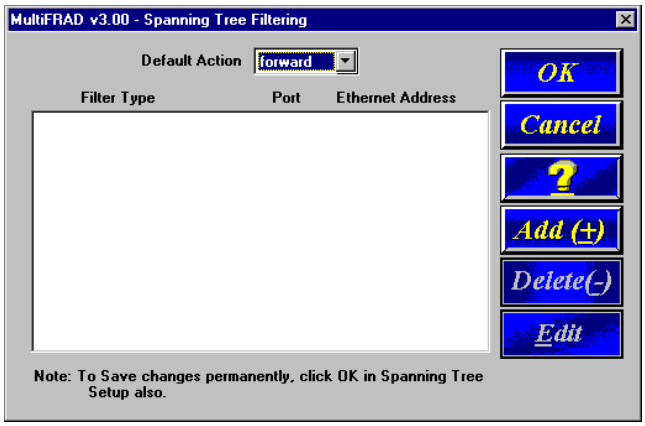
When the Bridging Enable option is enabled, the Spanning Tree Setup dialog box controls transparent bridging; however, if there are any loops or redundant links in the internetwork, the Spanning Tree Algorithm Enable option must also be enabled. Spanning Tree is a method of transparent bridging, as opposed to source route bridging which the MultiFRAD does not support.



The MultiFRAD defaults with one logical WAN port mapped to a DLCI. It is not necessary to map this port to a DLCI; however, care should be taken if an additional logical WAN is created. An additional WAN will default to a disabled state, and it must be mapped to a DLCI before it can be used. In most applications, the forwarding state should be enabled on the first logical WAN, and blocking should be set up on any additional WANs. While in operation, the MultiFRAD will automatically transition from blocking to forwarding, and vice versa, as necessary.

Filtering

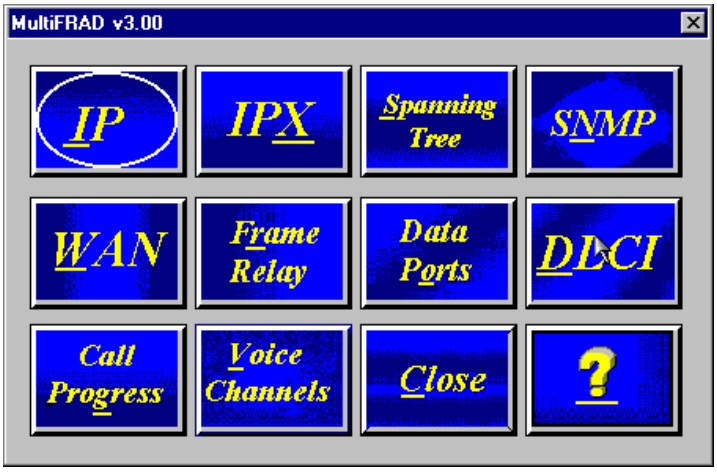
Clicking the **Filters** button on the Spanning Tree Setup dialog box displays the Spanning Tree Filtering screen. Here, you can toggle the packet Default Action from **forward** to **filter**.



Clicking the ***Add (+)*** button displays the **Add Spanning Tree Filter** dialog box, which enables you to designate the source or destination Ethernet Address, the Physical Port (LAN, or WAN 1), and the type of action desired; i.e., Forward Destination Address (default), Filter Destination Address, Forward Destination Address, or Forward Source Address. Clicking **OK** displays your selections on the **Spanning Tree Filtering** dialog box; however, note that to save changes permanently you will need to click **OK** on the **Spanning Tree Filtering** dialog box and then also click **OK** on the **Spanning Tree Setup** screen. (If you forget, you will be queried...)

Statistics

The Statistics dialog box enables you to view statistics on the major events of the MultiFRAD. The Statistics dialog box changes depending on the way the WAN port is configured. If the MultiFRAD is configured for point-to-point operation, the button to the right of the WAN button changes from “Frame Relay” to “PPP” and the DLCI button will no longer be active. If the WAN port is configured for frame relay, then the button to the right of the WAN reads “Frame Relay” and the DLCI button is active.

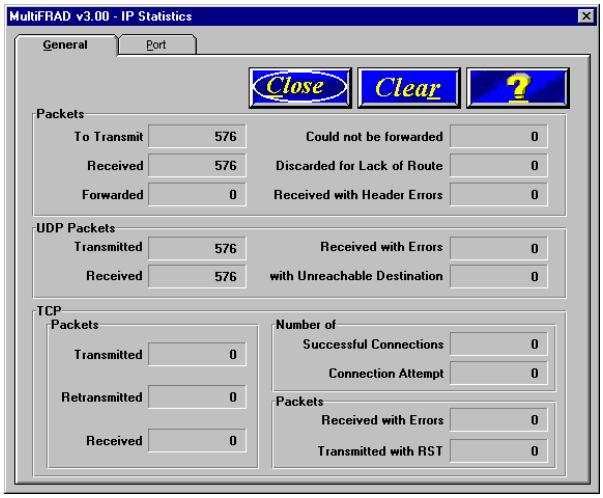


Statistics can be a useful troubleshooting tool. For example, the WAN Statistics show whether the MultiFRAD is sending or receiving on its composite link or WAN port. When the MultiFRAD is configured in a frame relay mode, it will transmit management frames approximately every ten seconds, trying to establish communication with the provider’s switch. If the unit is sending frames but not receiving any, this may be an indication of a problem with the link device or the frame relay network. Statistics in the frame relay dialog box show the actual number of management frames sent and received, and can also indicate a link or frame relay network problem. (One way to determine if a problem is local would be to set your DSU to internal clocking and put it in loopback mode using an RJ-45 DSU loopback cable. If the MultiFRAD, cable, and DSU are all functioning properly, the WAN statistics will reflect that fact by showing the same number of bytes received as transmitted.)

Another useful screen is DLCI Statistics, which shows the status of the PVC; e.g., it indicates whether the selected DLCI is “active” or “inactive” and shows if the MultiFRAD is experiencing network congestion (reflected by FECNs or BECNs received).

IP Statistics

IP is a connection-less network protocol that resides in the network layer of a conventional OSI layered model (for more information on this model, refer to Appendix C). Depending on what is going on at the application layer, IP will typically use one of two transport layer protocols. User Datagram Protocol (UDP), is a connection-less transport layer protocol used with TFTP or SNMP; and Transport Control Protocol (TCP) is a connection-oriented transport layer protocol used with FTP, Telnet, and SMTP.



UDP makes use of the port concept and has no measures for flow control, reliability, or error recovery. It is used when the full services of TCP are not required, and the reliability measures must be assumed by another layer.

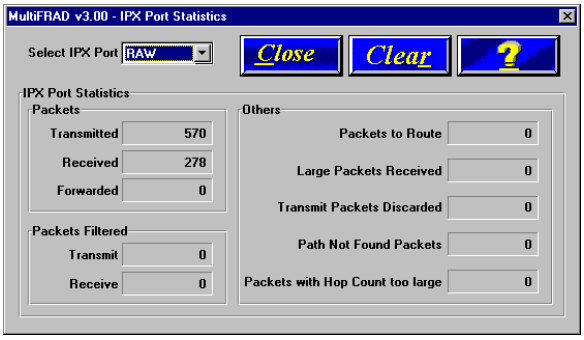
TCP works well in environments where the reliability measures are not assumed by other layers. It is connection-oriented and has a full range of services.

These statistics are primarily informational, and their use as a troubleshooting tool will be contingent on the applications running in the upper layers. For instance, if you were having problems connecting to MultiFRAD's Web server, you would look under the TCP section to make sure connections are being established. If not, perhaps the Web server is not enabled. Or, if you were having problems establishing a remote connection through TFTP, you could look in the UDP section to see if any packets are being received. If not, you may need to review your network addressing.

The Port Tab enables you to view generic IP statistics for a given Ethernet IP Port. The statistics for either the Ethernet (LAN) port or any logical IP WAN port can be viewed in this window. The practicality of statistical use in troubleshooting will depend on the application running in the upper layers.

IPX Port Statistics

The IPX Port Statistics dialog box displays information pertaining to the IPX Port; for example, the frame type used or the number of packets transmitted/received.

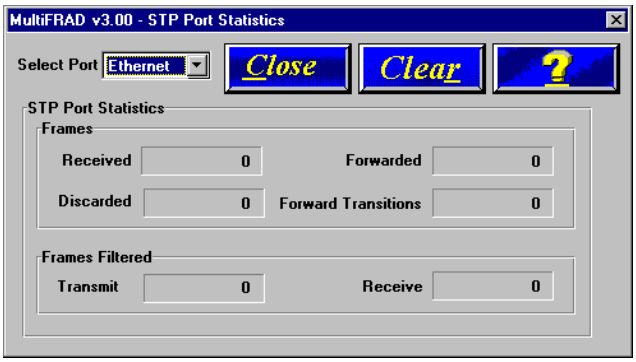


IPX is a network layer protocol usually associated with Novell Netware™ networks. It allows for encapsulation of four different frame types over a single physical LAN connection (provided each frame type has a unique network address): RAW (802.3), LLC (802.2), Ethernet II, and SNAP.

These statistics are mostly informational but could be useful for troubleshooting. For instance, if there was a question as to which frame type your workstation was using, you could view the statistics for each frame type and determine which one is being used by the amount of packets transmitted and received.

STP (Spanning Tree) Port Statistics

The STP (Spanning Tree) Port Statistics dialog box displays information regarding the selected STP port, for example, the number of frames discarded or forwarded.

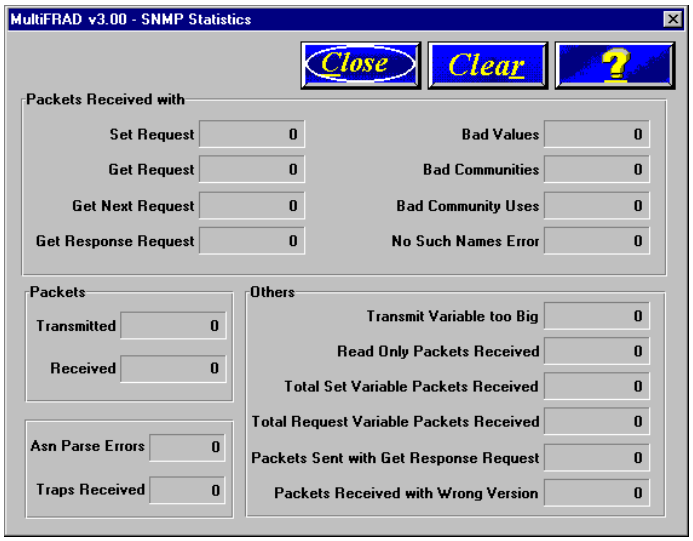


Spanning Tree transParent (STP) bridging is the method of bridging used by the MultiFRAD as specified in an IEEE 802.1D telecommunications standard. Enabling the spanning tree algorithm in addition to spanning tree bridging provides for a loop-free environment with redundant paths (if present) that will transition automatically from blocking to forwarding any time a root bridge failure occurs.

The STP Port statistics are mostly informational but can also be useful for troubleshooting. For example, you can check the number of forward transitions to ensure that the port has been active (in which case forward transitions will be greater than zero).

SNMP Statistics

The SNMP Statistics dialog box provides statistical information on Simple Network Management Protocol (SNMP).

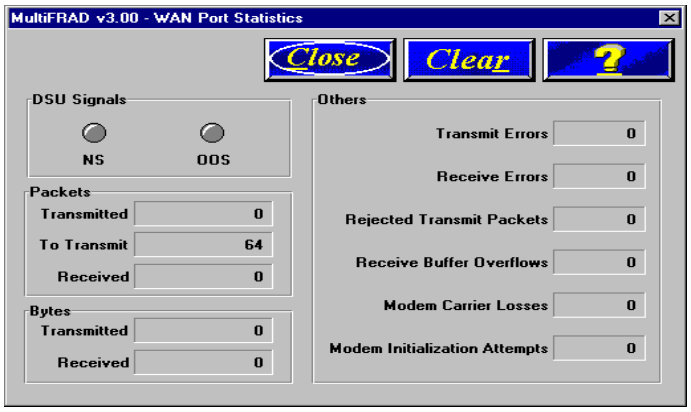


SNMP is an application layer protocol that facilitates the exchange of management information between network devices. There are three key components in SNMP: the devices that are to be managed, agents, and the network management systems. The managed device is the network device, such as a router. The agent is the network management software module residing in the managed device. The network management system runs the SNMP application that controls the managed devices and monitors their status. Four primary operations (Set, Get, Get Next, and Trap) are performed using SNMP and monitored for display on this screen of statistics.

You can use these statistics as a troubleshooting aid should you have a problem communicating with the MultiFRAD from your SNMP manager.

WAN Statistics

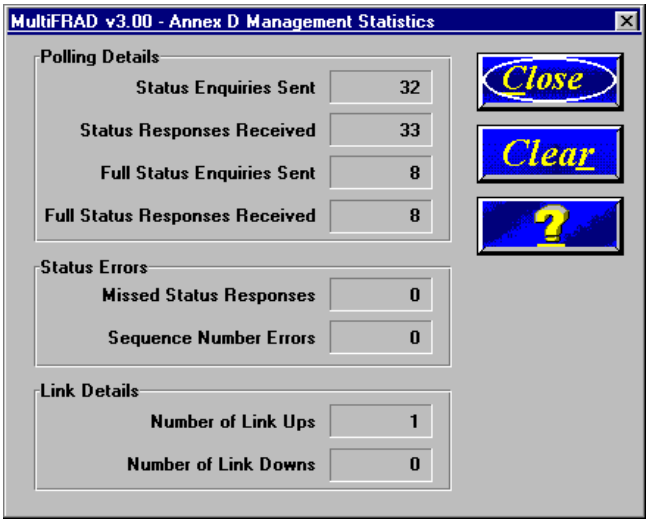
The WAN Port Statistics dialog box provides statistical information regarding the MultiFRAD's Composite Link port, including the number of packets transmitted/received, and to transmit, and the number of bytes transmitted/received.



This dialog box monitors the traffic on the MultiFRAD's composite link (WAN) port. The Statistics that fall into the "Others" category relate to the physical layer between the MultiFRAD and the link device; i.e., the CSU/DSU. These statistics can be helpful in troubleshooting suspected problems in the physical layer; e.g., the WAN port itself, the link device (CSU/DSU), and any associated cabling.

Frame Relay Statistics

The Frame Relay Management Statistics dialog box can be a useful tool for troubleshooting MultiFRAD installations and monitoring the performance of active links, and checking that the MultiFRAD is talking to the provider's switch.



The **Polling Details** section lists the various management frames sent and received. For every Status Enquiry Sent, a Status Response should be received from the network. Likewise, for every Full Status Enquiry Sent, there should be one Full Status Response received. The two status enquiry types are used by the FRAD to verify that the frame relay network is operational, and to determine which DLCIs are active. Under default settings a status enquiry is sent every ten seconds, and every sixth enquiry will be a Full Status Enquiry.

The Enquiries Sent and the Responses Received should increment together, and should be equal under normal circumstances. Any gap between them reflects a breakdown in communication with the provider's switch, and will be reflected as Missed Status Responses.

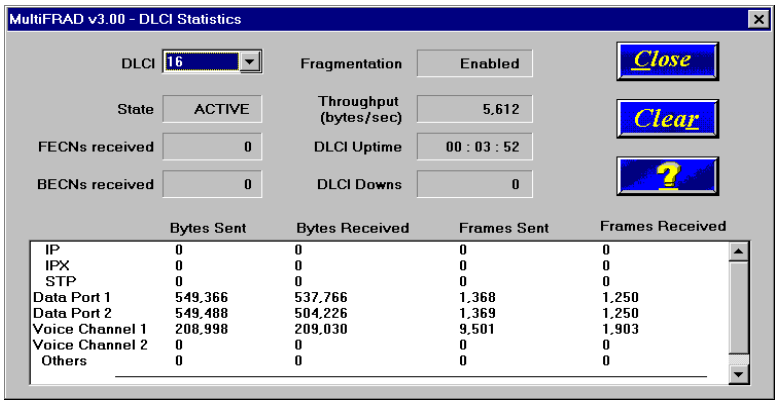
The **Status Errors** section lists the number of errors that have occurred. A Missed Status Response means the frame relay network did not respond to a status enquiry from the MultiFRAD before the next status enquiry was sent (by default there are 10 seconds between status enquiries).

A **Sequence Number Error** means the sequence numbers in a received status response did not match what the MultiFRAD expected based on its Status Enquiry. Basically, the Status Enquiry has two numbers (or counts), and one should be incremented by the network and then both numbers should be returned to the FRAD in the Status Response. Sequence Number Errors also reflect missing packets between the MultiFRAD and the switch, but are not a cause for alarm unless they are incrementing rapidly and steadily.

The **Link Details** section records the number of times the frame relay link between the MultiFRAD and the network has gone up (become active) or gone down (become inactive). The Link Details provide a more general picture of the status of communication between the MultiFRAD and the frame relay network.

DLCI Statistics

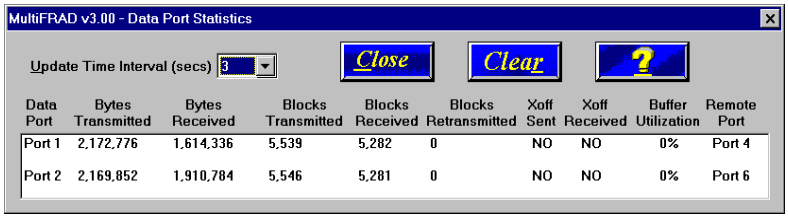
The DLCI Statistics dialog box shows the individual DLCI status and statistics. This information can be helpful in determining if the DLCI is active, if it is going up and down, and if the MultiFRAD is experiencing frame relay network congestion (FECNs/BECNs). It also gives an indication of the momentary throughput on individual DLCIs.


MultiFRAD v3.00 - DLCI Statistics
DLCI 16
Fragmentation Enabled
State ACTIVE
Throughput (bytes/sec) 5,612
FECNs received 0
DLCI Uptime 00 : 03 : 52
BECNs received 0
DLCI Downs 0
Close
Clear
?
Bytes Sent Bytes Received Frames Sent Frames Received
IP 0 0 0 0
IPX 0 0 0 0
STP 0 0 0 0
Data Port 1 549,366 537,766 1,368 1,250
Data Port 2 549,488 504,226 1,369 1,250
Voice Channel 1 208,998 209,030 9,501 1,903
Voice Channel 2 0 0 0 0
Others 0 0 0 0

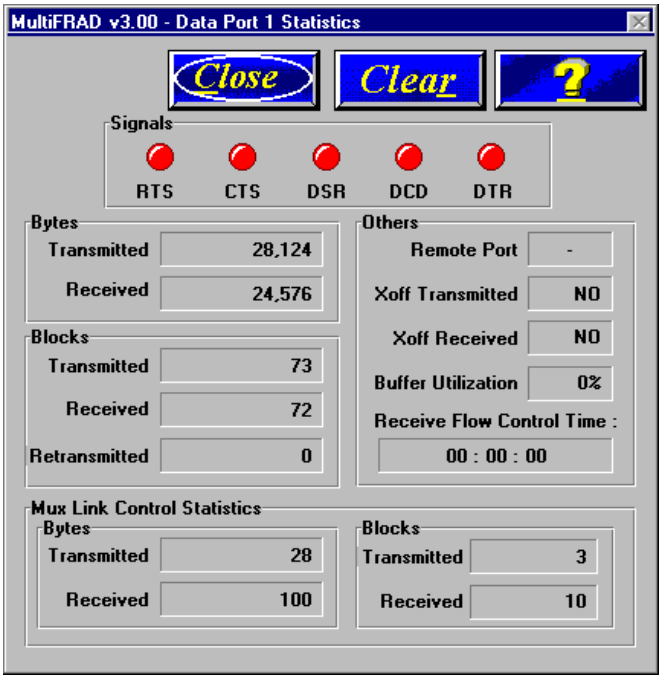
When troubleshooting a frame relay circuit, once it has been established that management frames are being sent and received, the next step is to determine whether the DLCIs are becoming active. This dialog box will provide that information. A FRAD needs to be present at both ends for the DLCI to be active. Keep in mind that the frame relay network tells the FRAD the status of the PVC with one of its status responses. But the network will not say the PVC is active until it has established management communication at both ends of the PVC. If the FRADs at both ends of the PVC show that they are communicating with the frame relay network and the DLCI still shows active, and there is a communication problem over that PVC, there may be a problem with your service provider. If all DLCIs show active at both (or all) locations and there is still an end-to-end communication problem, it is likely that it is in the configuration of the MultiFRAD. At that point, review your protocol stack/data port parameters and DLCI mappings.

Data Port Statistics

The Data Port Statistics dialog box displays statistical information, such as bytes or blocks received/transmitted, for the two data ports.


MultiFRAD v3.00 - Data Port Statistics
Update Time Interval (secs) 3
Close
Clear
?
Data Port Bytes Transmitted Bytes Received Blocks Transmitted Blocks Received Blocks Retransmitted Xoff Sent Xoff Received Buffer Utilization Remote Port
Port 1 2,172,776 1,614,336 5,539 5,282 0 NO NO 0% Port 4
Port 2 2,169,852 1,910,784 5,546 5,281 0 NO NO 0% Port 6

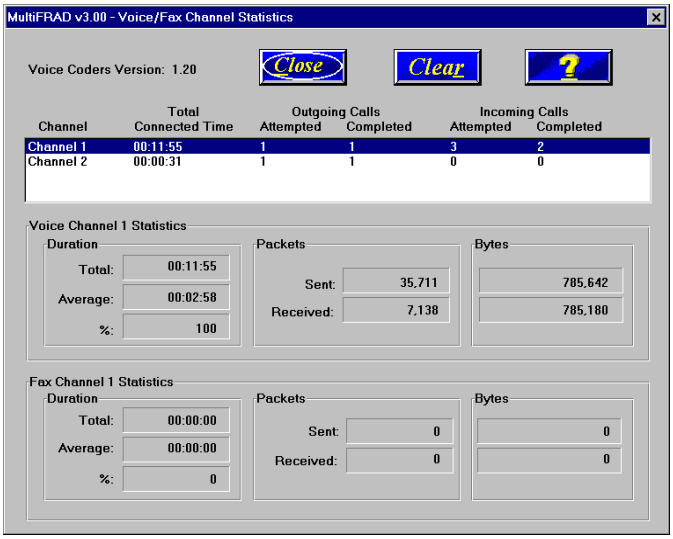
This window shows the statistics for both data channels. If you highlight and double-click Port 1 or Port 2 on this screen, you will display another screen of channel statistics and various hardware signals (RTS, CTS, DSR, DCD, DTR) and Xon/Xoff status. This second screen also displays buffer utilization percentage and receive flow control time.



These statistics may indicate that either the data channels, or more likely the devices attached to them, are being driven harder than they should be. Excessive buffer utilization and/or receive flow control time can usually be reduced or eliminated by slowing the speed at which the channel is operating.

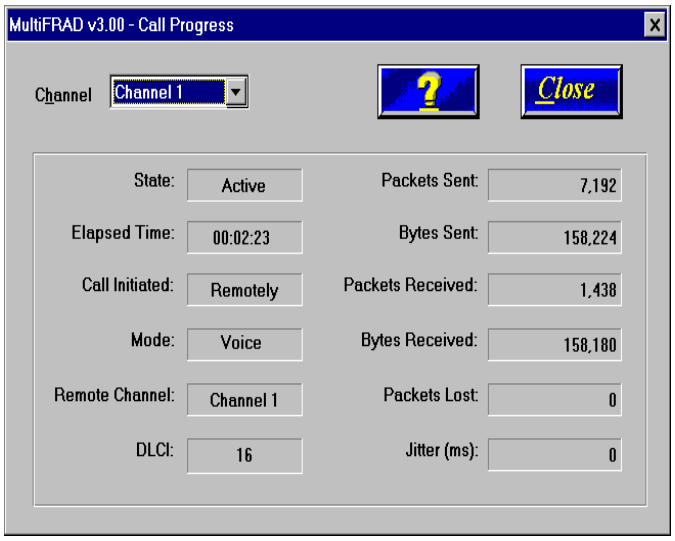
Voice Channel Statistics (FR221/V2 Only)

The Voice Channel Statistics dialog box displays statistical information, such as the total connected time, number of calls attempted and completed (both incoming and outgoing) for each voice channel. Also displayed are the duration, percentage and average usage, number of packets and bytes received/transmitted. Percentage refers to the ratio of voice/fax activity to total connected time. Clicking the Clear button will clear all the statistics on this dialog box.



Call Progress Statistics (FR221/V2 Only)

The **Call Progress Statistics** dialog box displays statistical information for the current activity, such as a call in progress. A drop-down list enables you to select which channel you want to monitor. After a channel is selected, all the relevant data for the current activity on that channel will be displayed in the fields provided. **Note:** the Packets Sent and Bytes Sent are for the local side of the current call. Packets Lost are those sent from the remote side that failed to reach the local side of the call.



WAN Port Setup

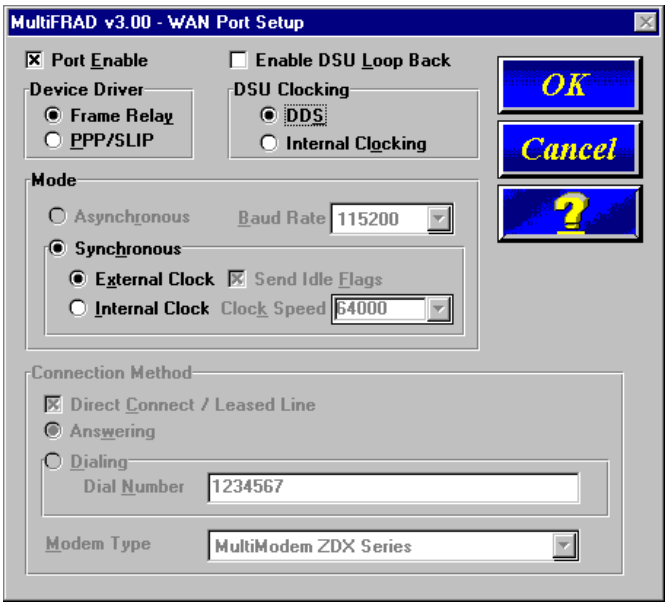
The WAN Port Setup dialog box selects whether the DSU port is enabled or not and controls how this port is configured (i.e., for frame relay or for point-to-point operation). For Frame Relay operation, you can ignore everything in the Mode and Connection Method groups on this dialog box. For point-to-point operation, the FR221/V2 voice/fax channels are not operational.

Note: Refer to Appendix D if in the future your WAN network is upgraded to T1/E1 and you then want to *disable* the MultiFRAD's internal DSU and use the back panel Trunk connection to obtain data rates of up to 2.048 Mbps.

Frame Relay

When the WAN port is configured for frame relay (the default), then the mode is Synchronous and DSU Clocking is set for external (DDS) clocking from the network. For Frame Relay operation, the DSU encapsulates data for transmission over a frame relay network. Additional frame relay configuration is necessary by clicking **Frame Relay** on the MultiFRAD main menu.

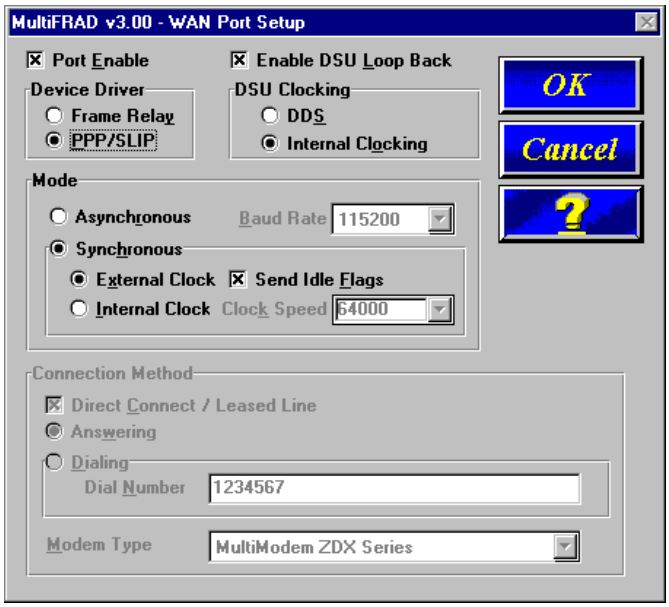
Note: The FR221 and FR221/V2 MultiFRADs use the DSU functions (Loop Back and Clocking) on this screen.



Point-To-Point

You can check communication between two MultiFRADs by cabling their DSU ports together with an RJ-45 cable, selecting point-to-point operation (PPP/SLIP), enabling DSU Loop Back, and setting one MultiFRAD to Internal Clocking and the other one to DDS. Data applied to the DSUs will be reflected both ways. Further configuration for point-to-point operation can be set up by clicking the PPP button on the main menu.

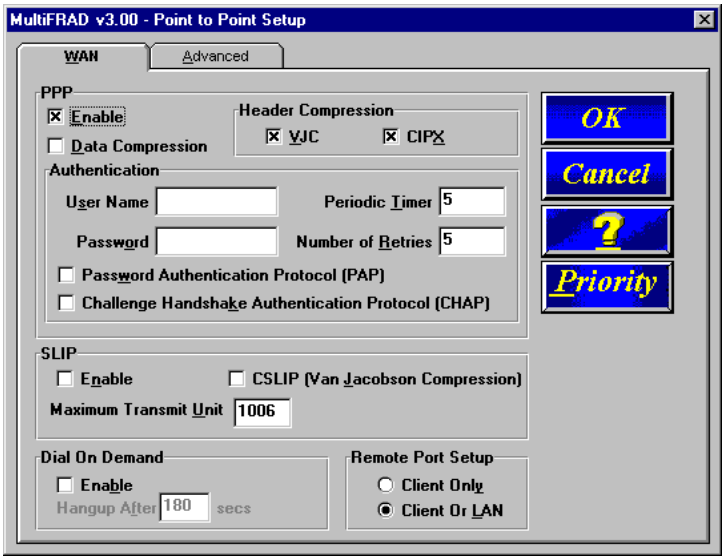
As an alternative (for diagnostic purposes), you can connect the TRUNK ports of two MultiFRADs together with a 25-pin back-to-back cable and transmit packets between the units.



Point to Point Setup

The Point to Point Setup dialog box controls the WAN port protocol, dial on demand, and remote port setup. The WAN port protocol can be either Point to Point Protocol (PPP) or Serial Line Internet Protocol (SLIP). PPP is the more robust of the two protocols in that it enables the endpoints to negotiate use of the link and protocol parameters in a standardized way and also provides for standardized encapsulation of the packets. SLIP is an older protocol that requires manual authentication using a script.

In order to display the PPP dialog box, the WAN Port Setup dialog box has to first be configured for PPP/SLIP.



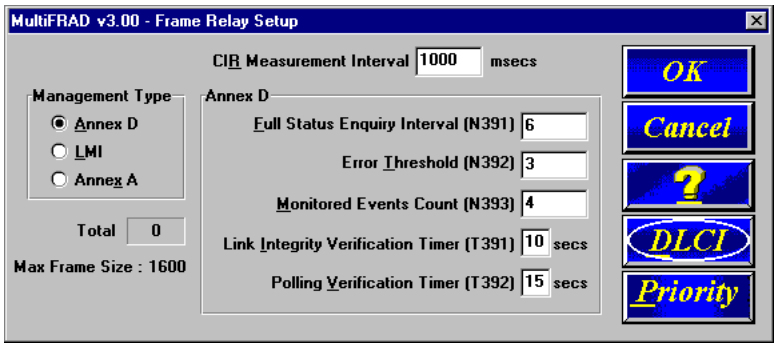
PPP is the default protocol. If SLIP is being used, click the PPP Enable option to disable PPP. Click on the SLIP Enable option. Determine if the TCP header is going to be compressed using VJC compression. If VJC compression is used, click the CSLIP (Van Jacobson Compression) option.

Two types of password authentication (PAP and CHAP) are supported for remote access clients and can be enabled here on the WAN tab. When either (or both) authentication protocols are enabled, the MultiFRAD expects the client at the other side of the link to be configured with a User Name and Password combination that is listed in its database. (Note: if there are no entries in the User database, any User Name and Password combination from a peer will be authenticated. For MultiFRAD-to-MultiFRAD connections, authentication normally is not used and the User Name and User Password fields are left empty.)

Enable SLIP if you are using this older protocol for communication on a dial-out WAN port. Either PPP or SLIP can be used on a dial-out port; however, on answering ports the MultiFRAD detects automatically the type of connection. If you enable CSLIP, the MultiFRAD will transmit and receive CSLIP packets. Packet size is limited by the Maximum Transmit Unit (MTU) value, for which the maximum setting (also the recommended setting) is 1006.

Frame Relay Setup

The Frame Relay dialog box displays the CIR Measurement Interval in milliseconds, the Management Type and details of that management type, and the number of DLCI's that are active. The MultiFRAD can detect DLCIs and the Management Type when you are connected to an active frame relay service. So it is important that if you change any frame relay parameters, that the new parameters agree with the way your frame relay service is provisioned.



In the Frame Relay Setup dialog box, you can change the Management Type by choosing one of the three options, then the detail parameters for that option are displayed to the right of the Management Type. For example, in the above dialog box, Annex D is the chosen management type with the Full Status Enquiry Interval [N391] set to 6 down thru Polling Verification Timer [T392] set to 15.

Usually, you will have no need to change the management type because the MultiFRAD will automatically detect the network's management type at power-up, or when the network becomes active. This feature takes about 1 to 2 minutes to detect the management type and get a list of the DLCI's.

Occasionally the Management Type parameters can be changed to correct a problem. In these cases, making the following changes could alleviate the problem:

1. Change the **Link Integrity Verification Timer**. This feature sets how often the MultiFRAD verifies that the link is good. Reducing the setting from the default value of 10 seconds to a lower value; e.g., 5 seconds, will increase the frequency of those verifications.

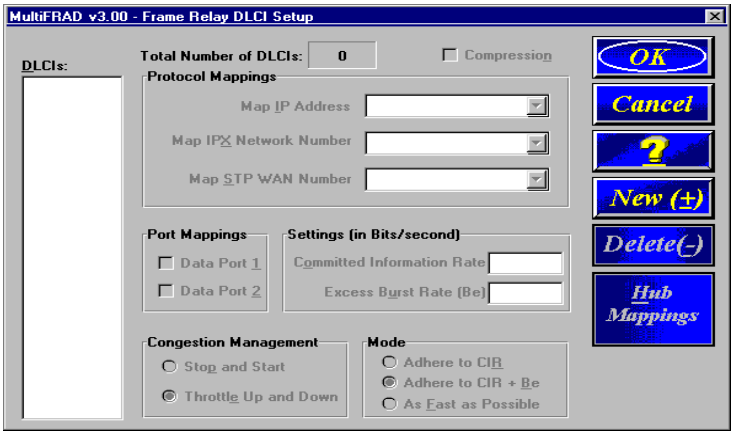
2. Change the **Full Status Enquiry Interval** to affect how often DCLI Status is updated. This parameter defines how often the MultiFRAD will send a request for DLCI status information along with the Link Integrity Verification request. The default value is to include such a request every sixth time the link integrity is checked. A value less than every sixth request will enable faster detection of active/inactive DLCIs, but will also produce a slight increase in management overhead.

3. Change the **Monitored Events Count** and the **Error Threshold** to affect the MultiFRAD's sensitivity to errors on the link. Every management frame received by the MultiFRAD is considered an event, and if the link integrity sequence numbers are wrong, for example, it is considered an "errored" event. With the default settings, if **Error Threshold** is 3 and **Monitored Events Count** is 4, and 3 out of 4 events are "errored", then the link is considered to be bad, and the FRAD stops sending on all DLCIs and restarts the initial procedures to activate the link.

4. Change the **CIR Measurement Interval** to change the time frame in which the FRAD calculates throughput for each DLCI. By default, every 1000 milliseconds (1 second), the MultiFRAD calculates how much information has been sent on each DLCI, and depending on the congestion management option for a DLCI the MultiFRAD may stop sending on that DLCI because it has exceeded its CIR or CIR+Be rating. By changing the CIR Measurement interval, the throughput calculations can be made more or less often.

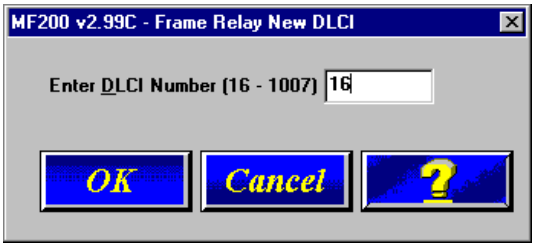
Note: performance could be compromised if the MultiFRAD is set to calculate throughput too often.

If you click the DLCI button on the right side of the dialog box, the Frame Relay DLCI dialog box is displayed.

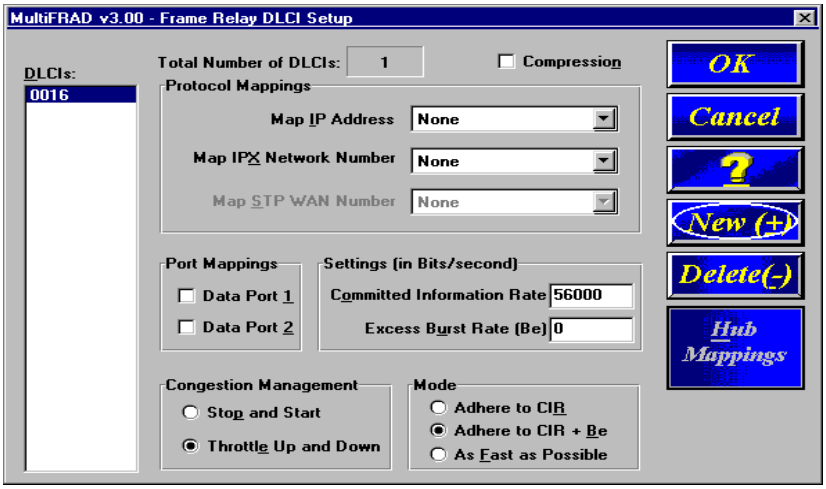


If you are connected to a frame relay service, this dialog box should display your current DLCI numbers automatically. It also shows the protocol mapping of the highlighted DLCI, which data ports are mapped to it, and how you set up your Congestion Management, Mode, CIR, and Be values. To change the mapping of a DLCI, highlight the DLCI number in the list on the left side of the dialog box. The dialog box will then change to the mapping of that DLCI. To add a new DLCI that has not been auto detected, click the New (+) button and the Frame Relay New DLCI dialog box is displayed.

To add a new DLCI Number, enter the number in the Enter DLCI Number window. You do not have to enter the leading zeros.



When you click the OK button, the new DLCI appears in the DLCI's window in the Frame Relay DLCI dialog box.

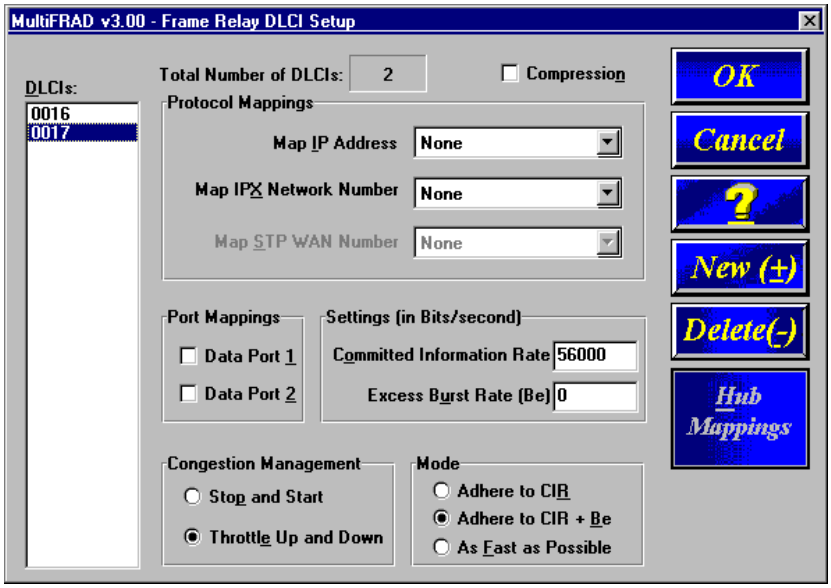


When a DLCI has just been detected, or if you have just created a new DLCI, then no protocols or data ports are yet mapped to it. The default Congestion Management, mode, CIR, and Be are displayed. You should verify these default settings with the way your new DLCI is provisioned by your service provider.

Congestion Management, Mode, and CIR/Be settings are used to avoid congestion and possible loss of data. The Committed Information Rate (CIR) and Excess Burst rate (Be) settings are throughput amounts determined by the network and user when each DLCI is ordered. The CIR is the basic throughput which the network will try to set aside for that DLCI. It will always be equal to or less than the actual access rate of the physical line (i.e., if the frame relay physical link is a 56K DDS line, the sum of the CIRs of all DLCIs on that link should not exceed 56K bps). The Be is the excess burst throughput rate (added to CIR) that the network should accept for that DLCI before significant loss of data occurs due to the discarding of frames during times of congestion. Note, however, that in frame relay there is no absolute guarantee of a congestion-free link, regardless of CIR and Be settings. The CIR and Be settings on the MultiFRAD should match the settings that the network has provisioned.

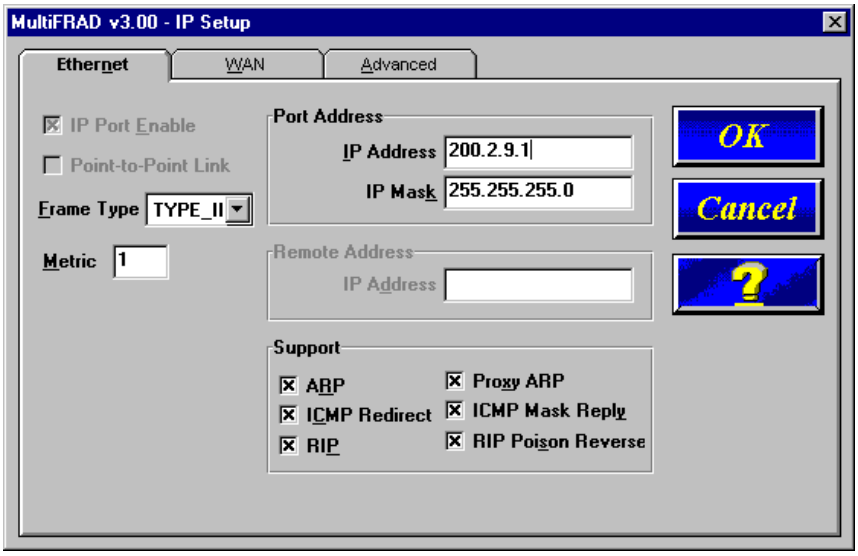
The Congestion Management and Mode settings determine how the MultiFRAD handles congestion. The Mode selects whether the MultiFRAD should use its own throughput calculations to avoid congestion, or simply send data to the network as fast as possible. The MultiFRAD calculates throughput after every CIR Measurement Interval, and can limit throughput to either the CIR (Adhere to CIR) or the CIR plus the Be (Adhere to CIR+Be). The Congestion Management setting selects whether the MultiFRAD should stop sending data when congestion is indicated (Stop and Start), or gradually reduce throughput during times of congestion (Throttle Up and Down).

Compression can be enabled on a per-DLCI basis by clicking on the Others-Compression box. If compression is required, it must be enabled on both the local and remote ends of the PVC.



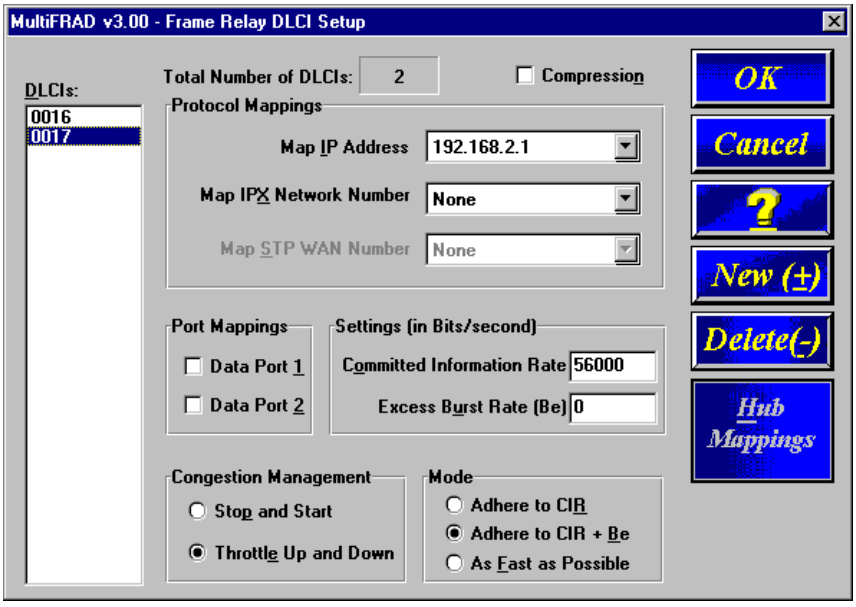
To map a protocol to a DLCI (e.g., 17), return to the MF200 main menu and then click the protocol stack that you are using. In the lower left part of the protocol stack dialog box a list of Logical WANs is displayed. To add a new logical WAN, click the Add (+) button and the next logical WAN number will appear in the list on the left hand side of the dialog box.

For example let's map our new DLCI 17 to the IP protocol as a WAN 2 with an IP Port Address of 192.168.2.1, an IP Mask of 255.255.255.0, and a remote IP Address of 192.168.2.2. From the MF200 main menu, click the IP button. The IP Setup dialog box is displayed. Click the WAN tab at the top of the dialog box. The WAN parameters are displayed. Click the Add (+) button and WAN 2 is added to the List of Logical WANs. Default IP addresses will be displayed for the Port Address and Remote Address and a default IP Mask will appear in its window. If either address or mask needs to be changed, click the appropriate window and the change the numbers.



When you click the OK button in the IP WAN dialog box, you now have an IP address for a second logical WAN. Now we have to tie that IP address to a DLCI, which in our example is DLCI 17. Now, return to the Frame Relay DLCI dialog box and highlight DLCI 17. Click the Protocol Mappings Map IP Address down arrow and the IP address 192.168.2.1 appears. Click this address and now IP address 192.168.2.1 is mapped to DLCI 17.

We now have WAN IP address 192.168.2.1 from the IP protocol stack mapped to DLCI 17. Let's say we also want to map a data channel to DLCI 17. The data ports that are already mapped to other DLCIs are grayed out. In our example, let's map data port 2 to DLCI 17. Simply click Port 2 in the Port Mappings group and an X appears in the box at the left of Port 2. Now we have both data port 2 and IP WAN address 192.168.2.1 mapped to DLCI 17. The MultiFRAD enables multiple sources of data to be mapped to the same DLCI because the MultiFRAD multiplexes all the data onto the DLCI. In other words, bandwidth for that DLCI is shared by all the data sources mapped to the DLCI. Of course this means that all the data sources must go to the same remote site, since the frame relay network will send all data on DLCI 17 to the same place.

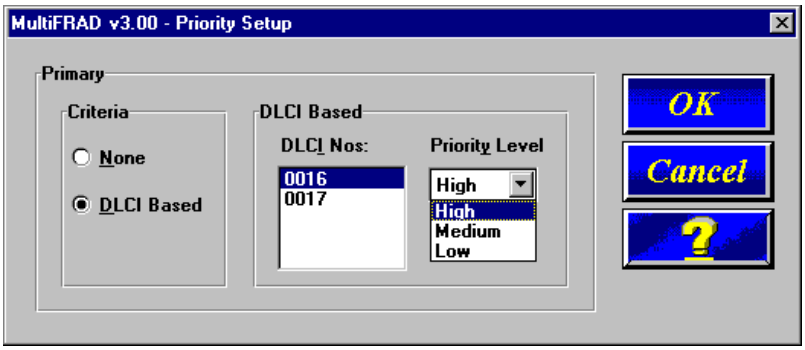


Packet Priority

Three levels of priority (High, Medium, and Low) are supported for data packets (i.e., IP packets, IPX packets, and STP packets), whether in frame relay or point-to-point mode. When priority levels are in use, the packets are processed based on their priority setup. To apply a priority level to a given DLCI, click the **Priority** button on the Frame Relay Setup dialog box, then select that DLCI on the Priority Setup dialog box and select the desired **Priority Level** from the drop-down list and click **OK**. After that, for frame relay operation the software checks for priority and then processes the packets on that DLCI accordingly.

Packet priority can be disabled by selecting **None** on the Priority Setup dialog box.

The Priority Setup dialog box for PPP has an option for **Port Based** priority replacing the **DLCI Based** option shown on the following screen; for PPP, select the Port (Port 1 or Port 2) where you want the priority applied, then select the desired **Priority Level** from the drop-down list.

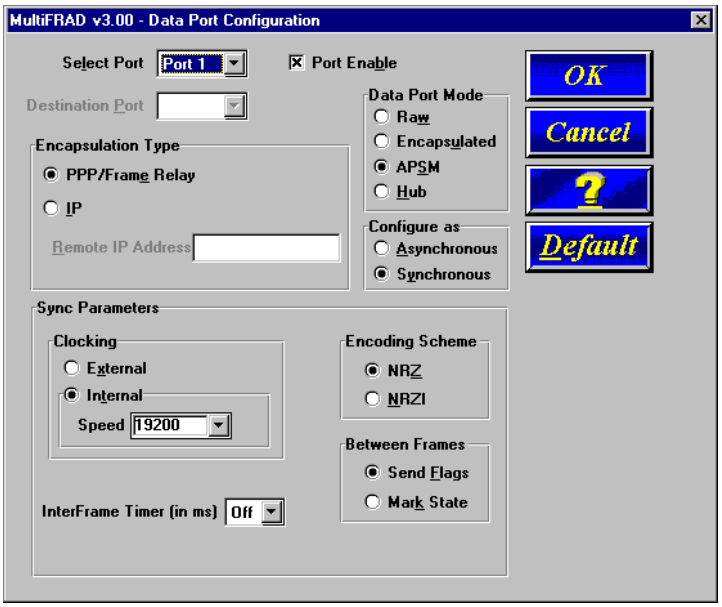


Data Port Configuration

This dialog box lets you leave both data ports enabled for normal data transfer operations or disable a given port if you do not want to transmit or receive data over it. The Destination Port parameter will be active only if both data ports have been mapped to the same DLCI.

For point-to-point operation, only APSM mode will be enabled. For frame relay operation, APSM mode allows both data ports and any protocol stacks to be mapped to a single DLCI. Encapsulated mode allows data from only one port with any other protocol mapping through a given DLCI. Raw mode allows the data of only one port to be transmitted, and the other port will not be able to transfer data on that DLCI.

For an asynchronous device, select Configure Asynchronous and configure the MultiFRAD to match your device. For a synchronous device, select Configure Synchronous, then configure the MultiFRAD to match your synchronous device. The Data Port Configuration dialog box also enables you to configure both data channels independently.



For example, Port 1 could be connected to a Multi-Tech MultiMux MMH904 and configured with the following options:

- Data Port Mode set to **APSM** (Advanced Priority Statistical Multiplexer),
- **Synchronous** Configuration,
- **Internal** Clocking with Speed set to **19200**,
- Encoding Scheme set to **NRZ** for all Multi-Tech Muxes,
- Between Frames set to **Send Flags**, and
- InterFrame Timer (in ms) has to be **Off**.

The MMH904 would have to be configured for an external composite link device. This means that the 8-position DIP Switch on the MMH904 would have to be toggled to the closed position and an external composite link cable connected between the MMH904 and the MultiFRAD **Channel 1** connector.

In most applications, the encoding scheme, interframe timer, and between frames will be used at their default settings. If you are unsure of your device's configuration, start with the defaults or refer to your device's documentation.

Changing Channel Parameters (FR221/V2 only)

Click the **Voice Channels** button on the main menu to display the **Voice/Fax Channel Setup** dialog box. The **Interface** tab is the default tab that appears whenever this dialog box is opened. The other two tabs contain voice and fax settings and the voice communications Tone Pairs for the MultiFRAD.

Interface

The **Interface** tab defines the interface type used on each voice/fax channel. The interface group contains three interfaces with the **FXS** divided into **Ground Start** and **Loop Start** (Loop Start is common). Use **FXS** when a telephone or fax machine is connected directly to the back panel of the MultiFRAD. Use the **FXO** interface for a station side connection to a telephone switch (PBX). Use the **E&M** interface for a trunk connection to a PBX.

Dialing Options and Auto Call options have to be considered for each interface; also, Pulse or DTMF dialing has to be selected for the FXO interface, and signal, mode, and wink timer (if wink signaling is used) also have to be considered for the E&M interface. To change a voice channel, you have to select Channel 1 or Channel 2. If the default interface (FXS) is used, you have to consider the signaling method (either loop start or ground start) and the Maximum Dial Digits (with a range of 1 to 16 and a default of 5). The value for **Max Dial Digits** can be increased without affecting the existing phone directory database. If you increase the value in this field, it merely means that any new phone numbers that are added to the database can have more than five digits.

FXO Interface

To use an FXO interface, you have to select (in the Regeneration group) the dialing type (pulse or DTMF; i.e., tone) used by your PBX. To determine the dialing type, contact the person in charge of your in-house telephone switch (PBX).

E&M Options

To use an E&M interface, you have to consider the dialing options, Auto Call option, signaling, mode, and if wink signaling is used, the wink timer. The E&M signal options of **Dial Tone** or **Wink** are based on how the E&M trunk on the PBX is configured. The dial tone is the sound you hear when you pick up the telephone. Wink signaling is part of the handshaking protocol between telecommunications devices which is a momentary interruption in signal indicating that a distant device is ready to receive the digits that have just been dialed. To determine which type of signaling to use, contact your in-house switch personnel. If wink signaling is used, the **Wink Timer** option becomes active which specifies in milliseconds the delay in sending address information to the remote MultiFRAD. The wink timer range is from 100 to 350 milliseconds with a default of 250 ms.

The **Max Dial Digits** field in the Dialing Options group indicates the longest phone number you can enter in the phone directory database. The value shown in this field is the maximum number of digits permitted in any phone number entered into the database. It does *not* represent an actual phone number. The range for the Maximum Dial Digits is 1 to 16 digits, and the default is 5 digits. As soon as you have entered the specified number of digits (when making a call), the MultiFRAD searches the Phone Directory Database for a DLCI that matches the phone number you entered.

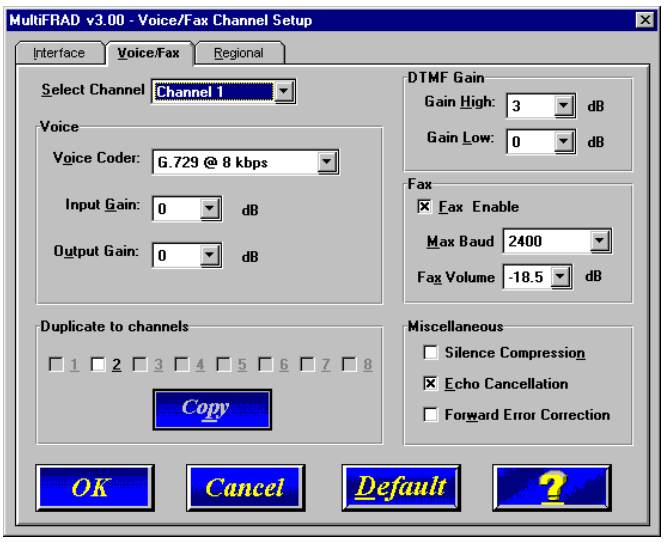
The **Inter Digit Time** option in the Dialing Options group defines (in milliseconds) the amount of time that the MultiFRAD waits between digits before searching its Phone Directory Database for that phone number. The range for the value of this option is 200 to 10,000 with a default of 2,000 milliseconds (i.e., two seconds), which is adequate for most applications.

Auto Call

The **Auto Call** option enables you to eliminate the dialing feature and as soon as you access the channel, the MultiFRAD connects to the frame relay circuit you identified with your DLCI number. The Auto Call group can be changed if a site is changed; e.g., a new site was added or a site was removed from your calling network. If a new site had been added and you wanted channel 2 of your local MultiFRAD to have a direct connection to this new site, you could enable the Auto Call option for channel 2 and then add in the DLCI number and remote channel number. If a site is removed from your calling network and you had Auto Call enabled, you can merely select the local channel and disable the Auto Call option here on the Interface tab.

Voice/Fax (FR221/V2 only)

The Voice/Fax tab controls the voice coder, Fax settings, DTMF gain, and some miscellaneous options.

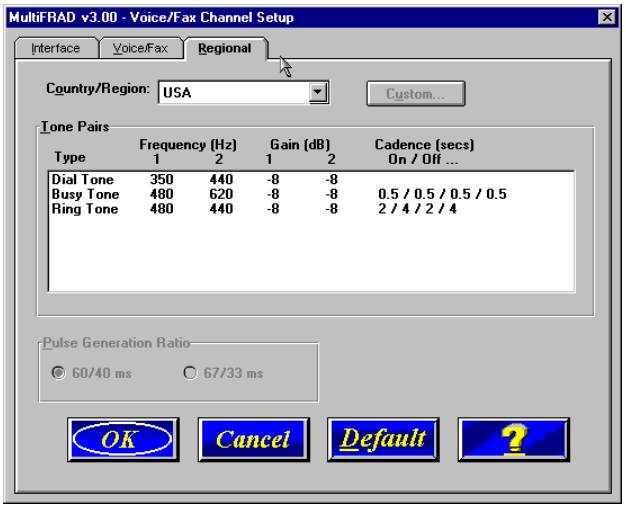


The MultiFRAD supports numerous state-of-the art ITU (International Telecommunications Union) voice coders. The **Voice Coder** drop-down menu enables you to select from a range of coders with specific bandwidths. The higher the bps rate, the more bandwidth is used. The channel you are calling has to be using the *same* voice coder; otherwise, you will always get a busy signal.

The **Fax** group enables a fax machine to transmit and receive faxes through the MultiFRAD. If a fax machine is connected to one of the voice/fax channels, the **Max Baud Rate** should be set to match the baud rate of the fax machine (e.g., 9600 or 14400); refer to user documentation. The **Fax Volume** setting controls the output level of the fax tones. These settings should be changed only under the direction of Multi-Tech's Technical Support personnel (see Chapter 6 - Warranty, Service and Tech Support).

Regional (FR221/V2 only)

The **Regional** tab controls the voice communications for the country or region in which the Multi-FRAD is being used.

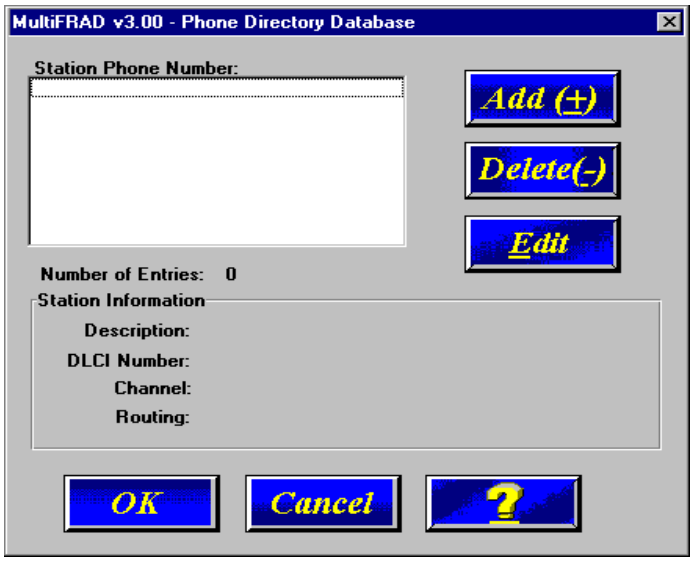


From the **Country/Region** drop-down list you can select the country or region for which you are configuring the MultiFRAD. The **Tone Pairs** group always displays the tones used in the country or region currently selected. In addition to Australia, Central America, Chile, Europe, France, Japan, UK, and USA, there is a Custom selection (with defaults identical to USA) that will make the **Custom** button active. Clicking the **Custom** button enables you to edit the **Tone Pairs** and establish custom sets of tone pairs for Dial Tone, Ring, and Busy on a **Custom Tone Pair Settings** dialog box.

The **Pulse Generation Ratio** group contains two ratios: the 60/40 ratio is for the USA, and the 67/33 ratio is for international applications.

Changing the Phone Directory Database (FR221/V2 only)

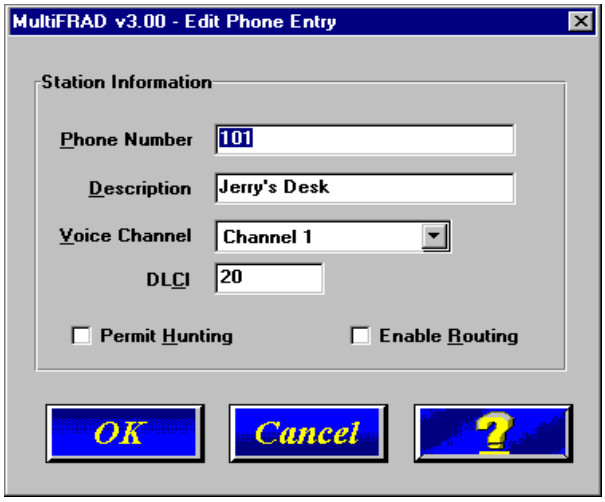
Clicking the ***Phone Book*** button on the main menu displays the **Phone Directory Database** dialog box, which displays the phone numbers of all the MultiFRADs in your network. The **Station Phone Number** field on this dialog box lists the phone numbers in numerical order. The **Station Information** group displays all the details (including the optional description, DLCI number, channel assignment, and shows whether routing is enabled or disabled) for whichever phone number (in the Station Phone Number list) is highlighted. When this dialog box displays, the first phone number is highlighted; however, you can click on any other number in the list to display its associated information.



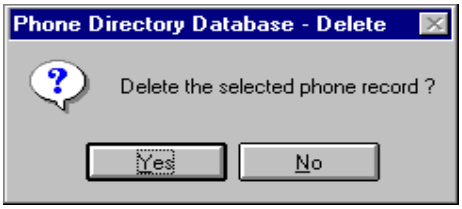
The ***Add(+)*** button on the **Phone Directory Database** dialog box enables you to add a new phone number to the database. (The phone number you enter does *not* have to be a conventional 7-digit phone number; for example, it does not have to be 717-5565. This number can be a single digit or several digits except it cannot be longer than the entry in the **Max Dial Digits** field in the Dialing Options group on the **Channel Setup** dialog box.) Clicking the **Add(+)** button displays the **Add Phone Entry** dialog box where you can assign a new Phone Number, add an optional Description, select the Voice Channel number and type the DLCI number in the fields provided. **Permit Hunting** enables a call to roll over to Channel 2 if Channel 1 is busy. Click **Enable Routing** if the packets are to be routed to another MultiFRAD rather than to the local phone interface. When done, click **OK** and the **Phone Directory Database** dialog box is displayed and includes the information you just added.

To change or delete an existing phone number, highlight the number on the **Station Phone Number** list on the **Phone Directory Database** dialog box, then click either the **Edit** or **Delete(-)** button. If you are editing an existing phone number, the **Edit Phone Entry** dialog box is displayed.

The ***Edit*** button on the **Phone Directory Database** dialog box enables you to edit any existing phone number in the database. Clicking the selected number, then clicking the ***Edit*** button displays the **Edit Phone Entry** dialog box where you can change the information in any field(s), permit hunting, or enable routing. Clicking **OK** displays the **Phone Directory Database** dialog box; the updated information will be displayed in the **Station Information** group when the edited phone number entry is highlighted.



The ***Delete(-)*** button on the **Phone Directory Database** dialog box enables you to remove any existing phone number and its related information from the database. Clicking the selected number, then clicking the ***Delete(-)*** button displays the following dialog box for confirming the deletion.



Clicking **Yes** displays the **Phone Directory Database** dialog box, where the deleted information will be gone. However, a mistake can be overriden by clicking the ***Cancel*** button at the bottom of the Phone Directory Database dialog box, providing an opportunity to return to this dialog box later to make the desired change(s).

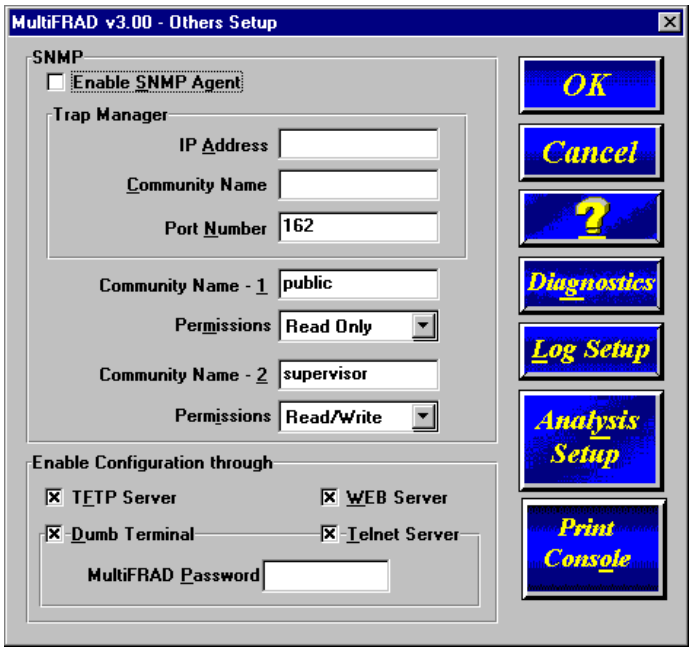
Others Setup

Clicking the **Others** button on the main menu displays the Others Setup dialog box. This dialog box lets you to enable SNMP Agent (the default is *disabled*) and set up all the necessary parameters; enable or disable various remote configuration methods such as TFTP (Trivial File Transfer Protocol) Server, Web Server, Dumb Terminal, and Telnet Server; and assign a Password to the MultiFRAD for Internet security. These applications enable remote viewing and changing of the MultiFRAD configuration, or updating firmware, from anywhere on the connected internetwork.

Verify that the desired applications are enabled (checked). The default condition is all applications are checked. To disable a given application, click to uncheck the check box and disable support.

SNMP related operations can be performed only when the SNMP Agent is enabled (checked) on this dialog box. The IP address of the system (i.e., SNMP Manager) that will receive the Traps from the Multifrad should be entered in the **IP Address** field in the Trap Manager group. The **Community Name** of the SNMP Manager receiving the Traps can be a maximum of 19 characters and is case sensitive. The default Port Number of the SNMP Manager receiving the Traps is 162. The MultiFRAD currently supports a maximum of two community users at a time, and they can be assigned either Read/Write or Read Only rights.

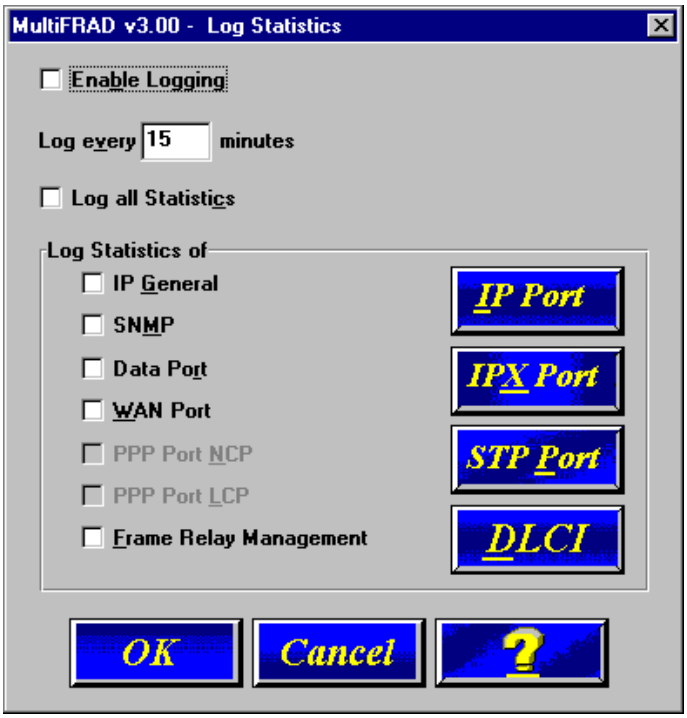
For more information on using these applications, click the on-line **Help** button or refer to Chapter 5, Remote Configuration and Management.



The Print Console that displays when you click the Print Console button presents a more detailed version of the Events list that appears at the bottom of the main menu.

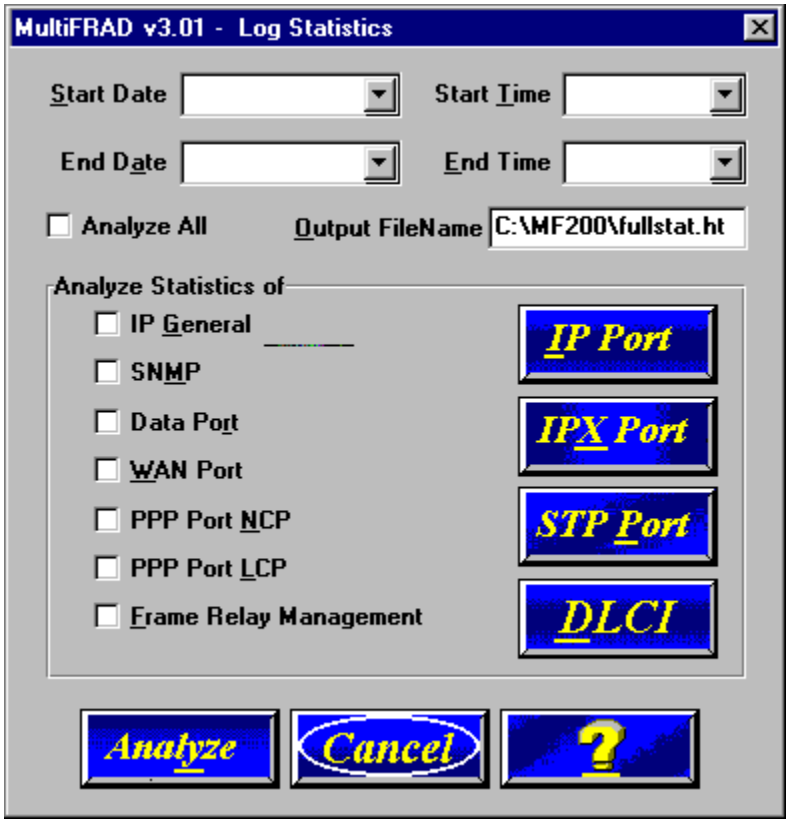
Enable Logging of Statistics

Clicking the ***Log Setup*** button on the **Others Setup** dialog box displays the **Log Statistics** dialog box which lets you Enable/Disable Logging, set the time interval (in minutes) between logging, and either Log all Statistics or only those statistics that you enable (check) on this dialog box. You can also select specific port data or DLCI data for logging by clicking the appropriate button(s).



Enable Analysis of Statistics

Clicking the ***Analysis Setup*** button on the **Others Setup** dialog box displays the **Log Statistics** dialog box. This dialog box lets you set the Start/Stop parameters (the start date/time and end date/time) for statistics logging, and enable **Analyze All** or analyze only certain statistics that you enable (check) on this dialog box. Here, too, you can designate the output file name, select specific port data or DLCI data for analysis (by clicking the appropriate buttons and making your selections), and then start the analysis process by clicking the ***Analyze*** button.



MultiFRAD™ 200-Series

Router/Two-Port Frame Relay Access Device with 56K DSU

Chapter 5 - Remote Configuration and Management

MultiTech® Systems

Introduction

This chapter provides procedures for viewing or changing the configuration of a remote unit. Two methods are provided to access a remote unit; the first method is modem based and the second method is using IP. Within the IP method, three applications can be used: 1) LAN-Based using TFTP (Trivial lFile Transfer Protocol), 2) Telnet as a client application, or 3) a standard Web browser on the Internet.

Remote Configuration

Remote configuration requires that the MultiFRAD software already be loaded on the local PC. The local PC then controls the remote MultiFRAD either via the modem connection or over the LAN.

Modem-Based

To remotely configure a MultiFRAD, a local PC needs to be connected to a dial-up line and the MultiFRAD software configured to call the remote MultiFRAD. The remote MultiFRAD needs to have a modem connected to a dial-up line and the Command Port. Once the connection to the remote unit is made, you can change the configuration as you see fit. Once the configuration is changed, you can download the new configuration to the remote MultiFRAD. Refer to the Modem-Based Remote Configuration Procedure in this chapter to remotely configure a MultiFRAD.

1 At the remote site, remove the serial cable from the PC to the Command Port connector on the back panel of the MultiFRAD.

2 At the remote site, connect a special cable (Remote Configuration Cable) from the Command Port connector on the back panel of the MultiFRAD to the RS232 connector on the modem. The special cable is a serial cable with male connectors on both ends. Refer to Appendix B for cable details.

Connect the modem to your local telephone line.

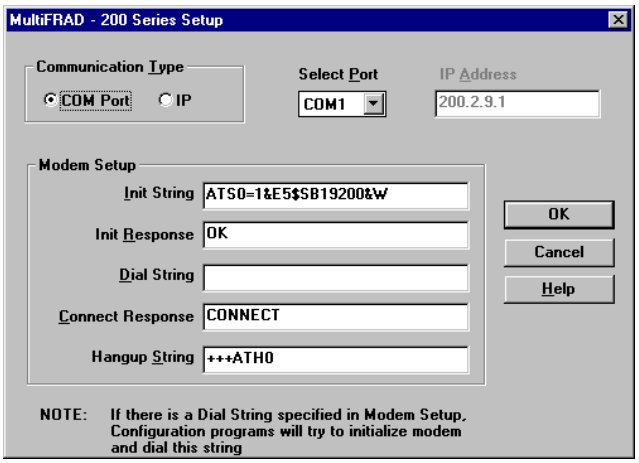
Provide your telephone number to the person verifying your configuration.

Configure the remote modem for 19200 baud and turn on Force DTR.

3 At the main site, connect your local PC to a modem that is connected to a dial-up line.

4 Install the MultiFRAD software on the local PC. When installed, click **Start | Programs | MultiFRAD 200 | Configuration Port Setup**, or double click on the **Configuration Port** icon in the MultiFRAD 200 program group.

5 The **MultiFRAD - 200 Series Setup** dialog box is displayed.



Verify that the **Communication Type** is set for **COM Port** and the **Select Port** field is set for the COM port of your local PC.

In the **Dial String** field, enter the AT command for dialing (ATDT) plus the phone number of the remote MultiFRAD.

If your Modem Initialization String, Initialization Response, or Connect Response values are different from the defaults in the dialog box, refer to your modem user documentation and change the default values to match your modem.

Click **OK** when you are satisfied with your selections.

6 Run the MultiFRAD Configuration program. Click **Start | Programs | MultiFRAD 200 | MultiFRAD Configuration**, or double-click the **MultiFRAD Configuration** icon in the MultiFRAD 200 program group.

7 The **Dialing** dialog box is displayed while software is dialing the remote MultiFRAD.

8 The **Reading Setup** dialog box is displayed.

9 The MultiFRAD main menu is displayed. This is the main menu for the remote MultiFRAD.

10 After you have changed the configuration of the remote MultiFRAD, click **Download Setup** to update the configuration. The remote MultiFRAD will be brought down, the new configuration written to the unit, and the unit will reboot.

11 Click **Exit** when the downloading is complete.

12 The **Hangup connection?** dialog box is displayed

Click **Yes** to disconnect the phone connection to the remote site.

13 If the same telephone number is not going to be used again in the immediate future, you may want to remove it from the Port Setup dialog box.

14 At the remote site, reconnect the MultiFRAD to the serial port of the PC and from the MultiFRAD 200 program group double click on the **MultiFRAD Configuration** icon to verify that the MultiFRAD is running.

LAN-Based

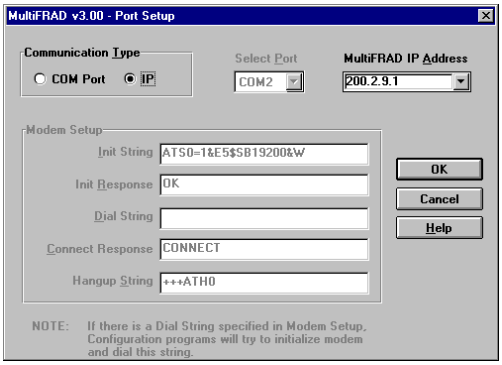
The LAN-based remote configuration requires a Windows Sockets compliant TCP/IP stack. TCP/IP protocol software must be installed and functional before the configuration program can be used.

1 You must assign an Internet (IP) address for the PC and for each node that will be managed by the configuration program. Refer to the protocol software documentation for instructions on how to set the IP addresses.

Once you have completed this step, you should be able to use the protocol Ping command for the PC host name. You should also test the network interface configuration by Pinging another TCP/IP device that is connected to the network.

2 Install the MultiFRAD software on the local PC. When installed click **Start | Programs | MultiFRAD 200 | Configuration Port Setup**, or double-click the **Configuration Port Setup** icon in the **MultiFRAD 200** program group.

3 The **MultiFRAD - 200 Series Setup** dialog box is displayed.



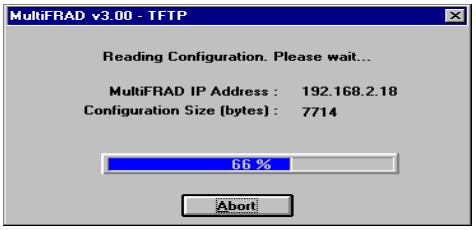
Verify that the **Communication Type** field is set **IP.**

In the **MultiFRAD IP Address** field, enter the IP Address of the remote MultiFRAD.

4 Click **OK** when you are satisfied with your selections.

5 Run the MultiFRAD Configuration program. Click **Start | Programs | MultiFRAD 200 | MultiFRAD Configuration**, or double-click the **MultiFRAD Configuration** icon in the **MultiFRAD 200** program group.

The **TFTP (Reading Configuration.)** dialog box is displayed.



6 The MultiFRAD main menu is displayed. This is the main menu of the remote MultiFRAD. Refer to the online Help provided with your MultiFRAD for the definition of each dialog box and field within the main menu or any related dialog box.

7 After you have changed the configuration of the remote MultiFRAD, click **Download Setup** to update the configuration. The remote MultiFRAD will be brought down, the new configuration written to the unit, and the unit will reboot.

8 Click **Exit** when the downloading is complete.

9 Double-click the **MultiFRAD Configuration** icon in the **MultiFRAD 200** program group to verify that the MultiFRAD is running by again displaying the MultiFRAD main menu .

Remote Management

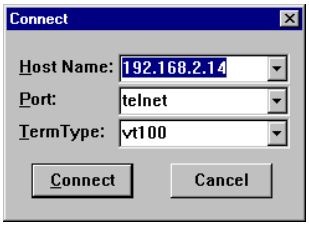
This section describes typical client applications that can be used to configure the MultiFRAD remotely. It is important to note that although any subsequent changes to configuration can be made using these applications, the initial setup and configuration of the MultiFRAD must be done using a local PC and the MultiFRAD software provided with your unit.

Although establishing access to the MultiFRAD varies between applications, the configuration functions mirror those of the MultiFRAD software. For more information on MultiFRAD software, refer to Chapter 4 - MultiFRAD Software.

Telnet

A typical Telnet client application is described next. The MultiFRAD has a built-in Telnet Server that enables Telnet client PCs to access and configure the MultiFRAD. In addition, the MultiFRAD can be remotely accessed and configured from any where on the Internet through its Web interface.

The TCP/IP stack has to be loaded before the Telnet client (a Windows application) will run. Also, the **Telnet Server** option has to be enabled on the **Others Setup** dialog box. Double-click the **Telnet** icon (or shortcut) and a blank Telnet screen is displayed. Click **Connect | Remote System** and the Connect dialog box is displayed. Select (or enter) a **Host Name** (the IP address of the MultiFRAD).In this example, the Host Name is 192.168.2.14.



When you enter a valid Host Name (IP address) and click **Connect**, you are immediately connected to the target MultiFRAD and the MultiFRAD Telnet Server screen is displayed.

MultiFRAD Telnet Server Menu

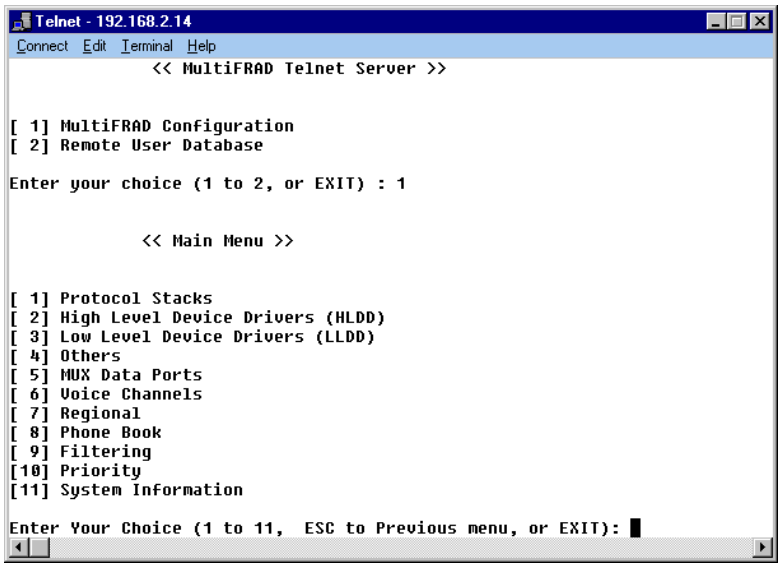
The MultiFRAD Telnet Server menu provides two basic options: MultiFRAD Configuration and Remote User Database. **Note:** the Database option is ***not used*** in this application. A third option (EXIT) enables you to close the Telnet session.

Telnet - 192.168.2.14
Connect Edit Terminal Help
MultiFRAD 200 Version 3.00
Copyright (C) 1995 Multi-Tech Systems, Inc.,
Multi-Tech Systems, Inc.,
2205 Woodale Drive, Mounds View,
Minnesota 55112, USA.
http://www.multitech.com
<< MultiFRAD Telnet Server >>
[1] MultiFRAD Configuration
[2] Remote User Database
Enter your choice (1 to 2, or EXIT) :

If you have entered a password requirement in the Applications Setup dialog box in the MultiFRAD software, once you choose the MultiFRAD Configuration option (1) on the MultiFRAD Telnet Server menu, you must enter your password to display the Main Menu.

MultiFRAD Configuration (Main Menu)

Selecting **Option 1** displays the MultiFRAD Configuration Main Menu, which enables you to view and change parameters on the protocol stacks, high and low level device drivers, enable or disable the supported servers, configure MUX data ports, set up filtering and priority, or view system information. Also, for the “/V2” version only, you can configure voice/fax channels 1 and 2, set up ‘Regional parameters, and build or edit the Phone Book Database.


Telnet - 192.168.2.14
Connect Edit Terminal Help
<< MultiFRAD Telnet Server >>
[1] MultiFRAD Configuration
[2] Remote User Database
Enter your choice (1 to 2, or EXIT) : 1
<< Main Menu >>
[1] Protocol Stacks
[2] High Level Device Drivers (HLDD)
[3] Low Level Device Drivers (LLDD)
[4] Others
[5] MUX Data Ports
[6] Voice Channels
[7] Regional
[8] Phone Book
[9] Filtering
[10] Priority
[11] System Information
Enter Your Choice (1 to 11, ESC to Previous menu, or EXIT):

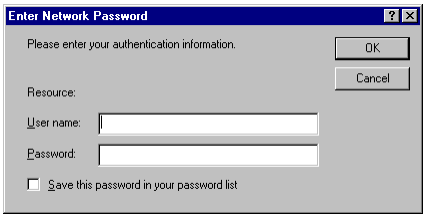
Web Browser Management

The MultiFRAD can be accessed, via a standard Web browser, from anywhere on the connected Internet. In order to provide this support, the **WEB Server** option has to be enabled from the **Others** button on the main menu which displays the **Others Setup** dialog box (see Chapter 4 - MultiFRAD Software). Depending on the rights of the user (read/write, or read only), it is possible to view the current parameters and statistics of the MultiFRAD as well as configure and download setup changes to the MultiFRAD.

You can access MultiFRAD Configuration by entering the **IP address** of the unit in the Address line of your Web browser. In this example, the IP address is 192.168.2.14. The following screen appears.

MultiFRAD
MultiTech Systems
Welcome to MultiTech's MultiFRAD Configuration
Click here to Login
MultiTech Systems
2205 Woodale Drive --- Mounds View, MN 55112 --- United States
TEL :(612) 785-3500 or (800)328-9717 ---FAX:(612)785-3702 or (800) 392-2432
Tech Support:(800)972-2439 ---Fax-back System:(612)717-5888
Web Site :www.multitech.com
FTP Site :ftp.multitech.com
Tech Support :tsupport@multitech.com

Click the word **Login** to gain access to the MultiFRAD; the following screen appears:



Enter the **User Name** “supervisor” (no **Password** is required), then click **OK**. The **MultiFRAD - 200 Configuration** menu is displayed.

Note: the first user to access the MultiFRAD will have *read/write* rights over the unit. All subsequent users will have *read only* rights, and some of the options in the Web interface will be inactive to them (i.e., will not be linked).

From the **MultiFRAD - 200 Configuration** menu, you can access current settings, view statistics, or configure and download a new setup to the MultiFRAD.

MultiFRAD™ 200-Series

Router/Two-Port Frame Relay Access Device with 56K DSU

Chapter 6 - Warranty, Service and Tech Support

MultiTech® Systems

Introduction

This chapter will provide you the resources for receiving service or support for your MultiFRAD. The chapter starts with a description of the warranty, and continues with instructions for contacting the Service department, Technical Support group, and various Multi-Tech Internet resources.

Limited Warranty

Multi-Tech Systems, Inc. (“MTS”) warrants that its products will be free from defects in material or workmanship for a period of two years from the date of purchase, or if proof of purchase is not provided, two years from date of shipment. MTS MAKES NO OTHER WARRANTY, EXPRESSED OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. This warranty does not apply to any products which have been damaged by lightning storms, water, or power surges or which have been neglected, altered, abused, used for a purpose other than the one for which they were manufactured, repaired by the customer or any party without MTS’s written authorization, or used in any manner inconsistent with MTS’s instructions.

MTS’s entire obligation under this warranty shall be limited (at MTS’s option) to repair or replacement of any products which prove to be defective within the warranty period, or, at MTS’s option, issuance of a refund of the purchase price. Defective products must be returned by Customer to MTS’s factory transportation prepaid.

MTS WILL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES AND UNDER NO CIRCUMSTANCES WILL ITS LIABILITY EXCEED THE PURCHASE PRICE FOR DEFECTIVE PRODUCTS.

On-line Warranty Registration

If you would like to register your MultiFRAD electronically, you can do so at the following address:

http://www.multitech.com/support/register.htm

Tech Support

Multi-Tech has an excellent staff of technical support personnel available to help you get the most out of your Multi-Tech product. If you have any questions about the operation of this unit, call 1-800-972-2439. Please fill out the MultiFRAD information (below), and have it available when you call. If your MultiFRAD requires service, the tech support specialist will guide you on how to send in your equipment (refer to the next section).

Recording MultiFRAD Information

Please fill in the following information on your MultiFRAD. This will help tech support in answering your questions. (The same information is requested on the Warranty Registration Card.)

Model No.: _____
Serial No.: _____
Software Version: _____

The model and serial numbers are on the bottom of your MultiFRAD.

Please note the type of external link device that is connected to your MultiFRAD before calling tech support. Also, note the status of your MultiFRAD including LED indicators, screen messages, diagnostic test results, DIP-Switch settings, problems with a specific application, etc. Use the space below to note the status:

_____

_____

_____

_____

_____

_____

_____

_____

Contacting Tech Support via E-mail

If you prefer to receive service on-line, via the Internet, you can contact Tech Support via e-mail at the following address:

http://www.multitech.com/_forms/email_tech_support.htm

Service

If your tech support specialist decides that service is required, your MultiFRAD may be sent (freight prepaid) to our factory. Return shipping charges will be paid by Multi-Tech Systems.

Include the following with your MultiFRAD:

- a description of the problem.
- return billing and return shipping addresses.
- contact name and phone number.
- check or purchase order number for payment if the MultiFRAD is out of warranty. (Check with your technical support specialist for the standard repair charge for your MultiFRAD).
- if possible, note the name of the technical support specialist with whom you spoke.

If you need to inquire about the status of the returned product, be prepared to provide the **serial number** of the product sent.

Send your MultiFRAD to this address:

MULTI-TECH SYSTEMS, INC.

2205 WOODALE DRIVE

MOUNDS VIEW, MINNESOTA 55112

ATTN: SERVICE OR REPAIRS

You should also check with the supplier of your MultiFRAD on the availability of local service and/or loaner units in your area.

The Multi-Tech BBS

For customers who do not have Internet access, Multi-Tech maintains a bulletin board system (BBS) that mirrors its FTP site. Information available from the BBS includes new product information, product upgrade files, and problem-solving tips. The phone number for the Multi-Tech BBS is (800) 392-2432 (USA and Canada) or (612) 785-3702 (international and local).

The BBS can be accessed by any asynchronous modem operating at 1200 bps to 33,600 bps at a setting of 8 bits, no parity, and 1 stop bit (8-N-1).

To log on to the Multi-Tech BBS

1. Set your communications program to **8-N-1**.
2. Dial our BBS at (800) 392-2432 (USA and Canada) or (612) 785-3702 (international and local).
3. At the prompts, type your first name, last name, and password; then press ENTER. If you are a first time caller, the BBS asks if your name is spelled correctly. If you answer yes, a questionnaire appears. You must complete the questionnaire to use the BBS on your first call.
4. Press ENTER until the Main Menu appears. From the Main Menu you have access to two areas: the Files Menu and News. For help on menu commands, type **?**.

To Download a File

If you know the file name

1. From the Main Menu, type **F** to access the Files Menu, then type **D**.
2. Enter the name of the file you wish to download from the BBS.
3. If a password is required, enter the password.
4. Answer **Y** or **N** to the automatic logoff question.
5. Select a file transfer protocol by typing the indicated letter, such as **Z** for Zmodem (the recommended protocol).
6. If you select Zmodem, the transfer will begin automatically. If you select another protocol, you may have to initiate the transfer yourself. (In most datacomm programs, the PAGE DOWN key initiates the download.)
7. When the download is complete, press ENTER to return to the File Menu.
8. To exit the BBS, type **G** and press ENTER.

If you don’t know the file name

1. From the Main Menu, type **F** to access the Files Menu. For a list of file areas, type **L**, press ENTER, then type **L** and press ENTER again. (If you do not type the second *L*, you will list all of the files on the BBS.)
2. Mark each file area you would like to examine by typing its list number and pressing ENTER.
3. Enter **L** to list all the files in the selected file areas. Enter **C** to go forward in the file list and **P** to go back.
4. To mark one or more files for download, type **M**, press ENTER, type the list numbers of the files, and press ENTER again.
5. Enter **D**. You will see a list of the files you have marked. Enter **E** if you would like to edit the list; otherwise enter **D** again to start the download process.
6. Select a file transfer protocol by typing the indicated letter, such as **Z** for Zmodem (the recommended protocol).
7. If you select Zmodem, the file will transfer automatically. If you select another protocol, you may have to initiate the transfer yourself. (In most data communications programs, the PAGE DOWN key initiates the download.)
8. When the download is complete, press ENTER to return to the File Menu.
9. To exit the BBS, type **G** and press ENTER.

About the Internet

If you prefer to receive technical support via the Internet, you can contact Tech Support via e-mail at the following address:

http://www.multitech.com/_forms/email_tech_support.htm

Multi-Tech's presence includes a Web site at:

http://www.multitech.com

and an ftp site at:

ftp://ftp.multitech.com

The ftp server mirrors the Multi-Tech BBS.

MultiFRAD™ 200-Series

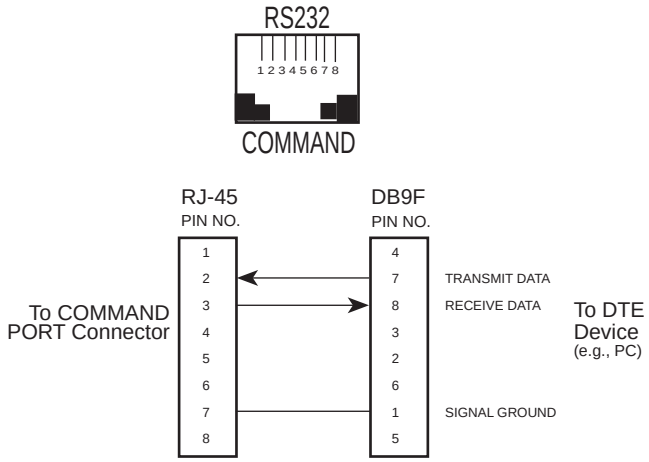
Router/Two-Port Frame Relay Access Device with 56K DSU

Appendixes

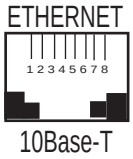
MultiTech® Systems

Appendix A - Cabling Diagrams

Command Port Cable



LAN Cable

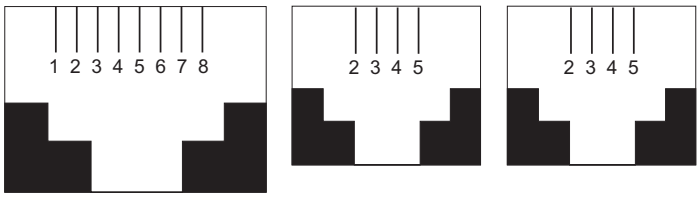


	10Base-T (RJ-45)	
Pin	Circuit	Signal Name
1	TD+	Data Transmit Positive
2	TD-	Data Transmit Negative
3	RD+	Data Receive Positive
4	RD-	Data Receive Negative

DSU Cable

DSU (RJ-45)	
Pins	Signal Name
1, 2	Transmit pair
7, 8	Receive pair

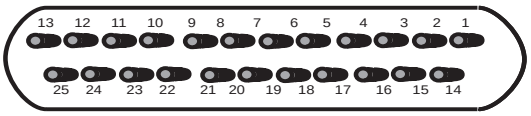
Voice/Fax Channel Connectors



Pin Connections

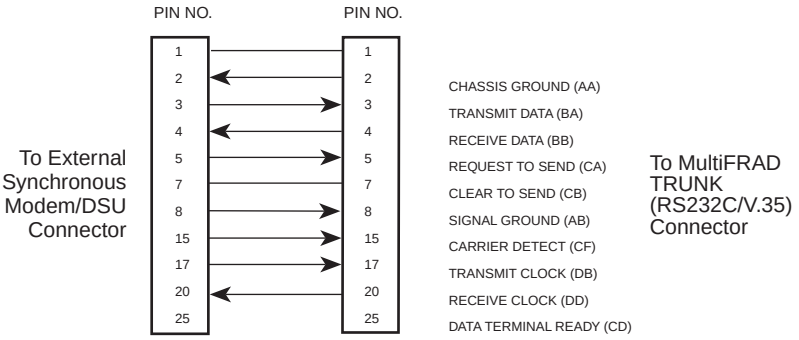
E&M	Description	FXO	Description	FXS	Description
1	M				
2	E	2	N/C	2	N/C
3	T1	3	Ring	3	Tip
4	R	4	Tip	4	Ring
5	T	5	N/C	5	N/C

Trunk Cable

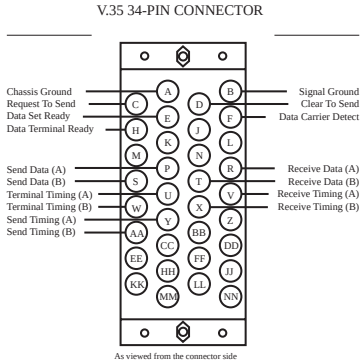


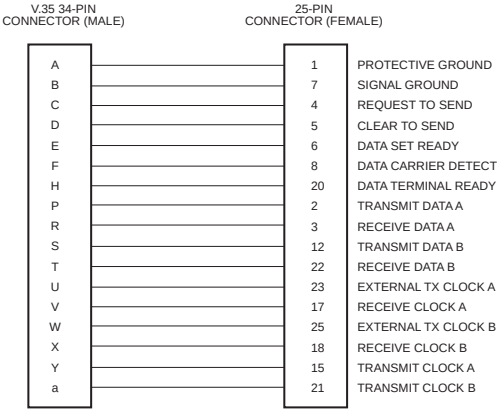
TRUNK (RS232/V.35)

RS232C/V.24 * Link Cable


PIN NO.
PIN NO.
1 2 3 4 5 7 8 15 17 20 25
1 2 3 4 5 7 8 15 17 20 25
CHASSIS GROUND (AA)
TRANSMIT DATA (BA)
RECEIVE DATA (BB)
REQUEST TO SEND (CA)
CLEAR TO SEND (CB)
SIGNAL GROUND (AB)
CARRIER DETECT (CF)
TRANSMIT CLOCK (DB)
RECEIVE CLOCK (DD)
DATA TERMINAL READY (CD)
To External Synchronous Modem/DSU Connector
To MultiFRAD TRUNK (RS232C/V.35) Connector

V.35 Adapter Cable Configured on a RS232C/V.35** Link Cable


V.35 34-PIN CONNECTOR
Chassis Ground
Request To Send
Data Set Ready
Data Terminal Ready
Send Data (A)
Send Data (B)
Terminal Timing (A)
Terminal Timing (B)
Send Timing (A)
Send Timing (B)
Signal Ground
Clear To Send
Data Carrier Detect
Receive Data (A)
Receive Data (B)
Receive Timing (A)
Receive Timing (B)
A B C D E F H J K L M N P R S T U V W X Y Z AA BB CC DD EE FF HH JJ KK LL MM NN
As viewed from the connector side


V.35 34-PIN CONNECTOR (MALE)
25-PIN CONNECTOR (FEMALE)
A B C D E F H P R S T U V W X Y a
1 7 4 5 6 8 20 2 3 12 22 23 17 25 18 15 21
PROTECTIVE GROUND
SIGNAL GROUND
REQUEST TO SEND
CLEAR TO SEND
DATA SET READY
DATA CARRIER DETECT
DATA TERMINAL READY
TRANSMIT DATA A
RECEIVE DATA A
TRANSMIT DATA B
RECEIVE DATA B
EXTERNAL TX CLOCK A
RECEIVE CLOCK A
EXTERNAL TX CLOCK B
RECEIVE CLOCK B
TRANSMIT CLOCK A
TRANSMIT CLOCK B

* The MultiFRAD RS232C interface circuits have been designed to meet the electrical specificaitons given in EIA (Electronic Industries Association) RS232C and CCITT (Consultative Committee International Telegraph and Telephone) V.24 Standards.

** When configured for V.35 interface operation on the link, the V.35 adapter cable should be used. This cable uses a 25-pin female connector at one end and a 34-pin winchester male connector at the other end.

Appendix B - Regulatory Information

Class A Statement

FCC Part 15

NOTE: This equipment has been tested and found to comply with the limits for a **Class A** digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

This device complies with Part 15 of the FCC rules.
Operation is subject to the following two conditions:

(1) This device may not cause harmful interference.

(2) This device must accept any interference that may cause undesired operation.

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Industry Canada

This **Class A** digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numerique de la classe A respecte toutes les exigences du Reglement sur le materiel brouilleur du Canada.

Fax Branding Statement

The Telephone Consumer Protection Act of 1991 makes it unlawful for any person to use a computer or other electronic device, including fax machines, to send any message unless such message clearly contains the following information:

- Date and time the message is sent
- Identification of the business or other entity, or other individual sending the message
- Phone number of the sending machine or such business, other entity, or individual

This information is to appear in a margin at the top or bottom of each transmitted page or on the first page of the transmission. (Adding this information in the margin is referred to as *fax branding*.)

Since any number of Fax software packages can be used with this product, the user must refer to the Fax software manual for setup details. Typically, the Fax branding information must be entered via the configuration menu of the software.

FCC Part 68 Telecom

1. This equipment complies with Part 68 of the Federal Communications Commission (FCC) rules. On the outside surface of this equipment is a label that contains, among other information, the FCC registration number. This information must be provided to the telephone company.

2. As indicated below, the suitable jack (Universal Service Order Code connecting arrangement) for this equipment is shown. If applicable, the facility interface codes (FIC) and service order codes (SOC) are shown.

3. An FCC-compliant telephone cord with modular plug is provided with this equipment. This equipment is designed to be connected to the phone network or premises wiring using a compatible modular jack which is Part 68 compliant. See installation instructions for details.

4. If this equipment causes harm to the phone network, the phone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice is not practical, the phone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

5. The phone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the phone company will provide advance notice in order for you to make necessary modifications in order to maintain uninterrupted service.

6. If trouble is experienced with this equipment (the model of which is indicated below) please contact Multi-Tech Systems, Inc., at the address shown below for details of how to have repairs made. If the equipment is causing harm to the network, the phone company may request that you remove the equipment from the network until the problem is resolved.

7. No repairs are to be made by you. Repairs are to be made only by Multi-Tech Systems or its licensees. Unauthorized repairs void registration and warranty.

8.

Manufacturer:	Multi-Tech Systems, Inc.
Trade name:	MultiFRAD 200
Model Numbers:	FR221, FR221/V2
FCC Registration Number:	AU7USA-25715-DF-N
Modular Jack (USOC):	RJ-11C or RJ-11W
Service Center in U.S.A.:	Multi-Tech Systems Inc. 2205 Woodale Drive Mounds View, MN 55112 (612) 785-3500 Fax (612) 785-9874

Canadian Limitations Notice

Ringer Equivalence Number

Notice: The ringer equivalence number (REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a phone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the ringer equivalence numbers of all the devices does not exceed 5.

Notice: The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations. Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, phone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

CE

EMC, Safety and Terminal Directive Compliance

The CE mark is affixed to this product to confirm compliance with the following European Community Directives:

Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of Member States relating to electromagnetic compatibility.

and

Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits:

and

Council Directive 98/13/EC of 12 March 1998 on the approximation of the laws of Member States concerning telecommunications terminal and Satellite earth station equipment.

Appendix C - Network Overview

Network architecture defines how computer equipment and other devices are linked together to form a communications system that enables users to share information and resources. There are proprietary network architectures and open architectures like the Open Systems Interconnection (OSI) model defined by the International Organization for Standardization (IOS). The OSI model defines a layered model for an open systems environment in which a process running in one computer communicates with a similar process on another computer if they implement the same OSI layer communications protocol. The OSI protocol stack shown in Figure B-1 is commonly used as a reference. During a communications session, processes running in each layer on each computer communicate with one another. The bottom layer defines the actual physical components such as connectors and cable and the electrical transmission of data bits between systems. The layers immediately above define data packaging and addressing methods. Still further up are methods for keeping communication sessions alive. Finally, the uppermost layers describe how applications use the underlying communication systems to interact with applications on other systems.

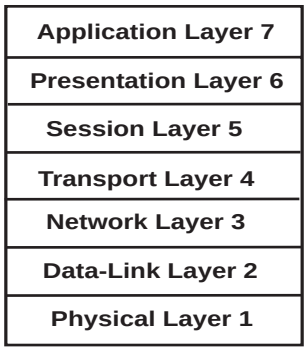


Figure B-1. OSI Protocol Stack

Protocols are loaded into a computer as software drivers. Each layer of the protocol stack defines a specific set of functions. An application at the uppermost layer interacts with the layer below when it needs to send information to another system on the network. The request is packaged in one layer and passed down to the next layer, which adds information related to functions handled at that layer, creating a new packet within a packet. This package is then passed down to the next layer and the process continues. Each layer adds information to the message packet and this information is read by the corresponding layer in the receiving system's protocol stack. In this way, each protocol layer communicates with its corresponding protocol layer to facilitate communication.

The physical layer defines the physical characteristics of the interface, such as mechanical components and connectors, electrical aspects such as voltage levels representing binary values, and functional aspects such as setting up, maintaining, and taking down the physical link. Well known physical layer interfaces for data communication include RS-232 and RS-449, the successor to RS-232.

The data-link layer defines the rules for sending and receiving information across the physical connection between two systems. This layer encodes and frames data for transmission, in addition to providing error detection and control. Because the data-link layer can provide error control, higher layers may not need to handle such services. However, when reliable media is used, there is a performance advantage by not handling error control in this layer, but in higher layers.

The Network layer defines protocols for opening and maintaining a path on the network between systems. It is concerned with data transmission and switching procedures, and hides such procedures from upper layers. The network layer can look at packet addresses to determine routing methods. If a packet is addressed to a workstation on the local network, it is sent directly there. If it's addressed to a network on another segment, the packet is sent to a routing device, which forwards it on the network. Some common protocols occupying the network layer are Internet Protocol (IP), X.25, Novell's Internetwork Packet Exchange (IPX), Banyan's VINES Internet Protocol (VIP).

The transport layer provides a high level of control for moving information between systems,

including more sophisticated error handling, prioritization, and security features. It provides quality service and accurate delivery by providing connection-oriented services between two end systems. The transport layer controls the sequence of packets, regulates traffic flow, and recognizes duplicate packets. It assigns packetized information which is a tracking number that is checked at the destination. If data is missing from the packet, the transport layer at the receiving end arranges with the transport layer of the sending system to have packets retransmitted. This layer ensures that all data is received and in the proper order.

The session layer coordinates the exchange of information between systems by using conversational techniques, or dialogues. Dialogues are not always required, but some applications may require a way of knowing where to restart the transmission of data if a connection is temporarily lost, or may require a periodic dialog to indicate the end of one data set and the start of a new one.

Presentation layer protocols are part of the operating system and the application the user runs on a workstation. Information is formatted for display or printing in this layer. Codes within the data, such as tabs or special graphics sequences, are interpreted. Data encryption and translation of other character sets are also handled in this layer.

Applications access the underlying network services using defined procedures in this layer. The application layer is used to define a range of applications that handle file transfers, terminal sessions, and message exchanges. Data starts at the application and presentation layers, where a user works with a network application, such as an electronic mail program. Requests for services are passed through the presentation layer to the session layer which begins the process of packetizing the information. A connection-oriented communication session may be opened between the two systems to provide reliable transmissions. Once the session is established, protocol layers begin exchanging information as appropriate.

Packet

A packet is a package of data that is exchanged between devices over a data communications link. Data exchanged between devices may include messages and commands, control codes for managing the session, and data. Information is placed in packets by various communications subsystems of the transmitting system, then framed into a serial bit-stream and sent across the communications link. One of the main reasons for packetizing and framing information is that errors on the communication link only affect a small, discernible part of the transmission, which is easily retransmitted.

The process starts at the application layer. An application in one computer has some information to send to another computer. The information is sent down through the protocol stack, across the wire, and up through the protocol stack of the other computer. This information takes the form of a protocol data unit (PDU). As the PDU moves through the layers of the sending computer, each layer attaches specific information to the PDU that is relevant to the protocols in that layer. This attached information is destined for the peer layer in the receiving computer. For example, the transport layer in the sending computer adds a sequence number to the PDU. This sequence number is read by the transport layer in the receiving computer to resequence the packets.

The communication protocol defines the packet structure and the networking system in use and defines the frame structure for bit-stream transmission. Each protocol layer attaches information destined for its peer layer in the other computer. When the PDU reaches the physical layer, it is transmitted as a stream of bits. On copper wire, the bit-streams take the form of voltage level changes that represent binary ones and zeros. The data-link layer places the PDU in one or more frames and uses a media access method (such as CSMA/CD or token) to gain access to the transmission media. The PDU might be subdivided into a number of separately addressed frames. The frame format is defined by the network in use. For example, Ethernet defines frames that can hold up to 1,500 bytes of packet data.

In general, a packet is a collection of information that contains data (payload) and headers (pilot). Headers include the source and destination address as well as control information to handle errors and keep packets flowing properly. Each packet is a separate block of information that can have a

different destination address, and in some cases, different sizes. A typical packet holds 512 bytes of information, so it takes many packets to transfer a large file over a network.

As packets traverse a network, the addressing information contained in them is used by bridges and routers to direct packets to their destination, or keep them off of networks where they don't belong. Routers direct packets along a specific path that has been predetermined as the best route to the packets' destination. Routers use algorithms to determine efficient paths in conjunction with other routers on the network. Administrators can also manually configure routers, based on the cost or speed of routes. Information can be transmitted to another system using either connection-oriented or connection-less methods. A connection-less session is more efficient for short, bursty transmissions since a session setup is not required, but the end system may need to perform more work to resequence packets that arrive out of order and check for lost packets.

Network Address

Every node on a network has an assigned address that other nodes use when communicating with it. For Ethernet and token ring network adapters, unique addresses are assigned at the factory. ARCNET networks have user-definable addresses. For example, the address of an Ethernet and token ring network adapter consists of a 6-byte address, half of which is a special number identifying the board's manufacturer. The last half of the address is a unique number for the board assigned at the factory. This strategy virtually guarantees that no two Ethernet or token ring network interface cards will ever have the same address and prevents conflicts.

When separate networks are connected into an internetwork, a new addressing scheme is required. On interconnected NetWare networks, each network segment has its own address, which is used for routing purposes and differentiate each segment from the others.

In TCP/IP networks such as the Internet, every node has a numeric address that identifies both a network and a local host or node on the network. This address is written as four numbers separated by dots, for example 148.1.9.1. The assignment of addresses is arbitrary within a company or organization, but if the company plans to connect with the Internet, it is important to obtain registered addresses from an outside agency to conform with international addressing standards. Applications running in computers also have addresses that other applications, either local or remote, use to communicate with the application. On TCP/IP networks, a socket is a combination of an Internet address plus an application address.

Internet Protocol (IP)

Internet Protocol is a connection-less communication protocol that by itself provides a datagram service. Datagrams are self-contained packets of information that are forwarded by routers based on their address and the routing table information contained in the routers. Datagrams can be addressed to a single node or to multiple nodes. There is no flow control, acknowledgment of receipt, error checking, and sequencing. Datagrams may traverse different paths to the destination and thus arrive out of sequence. The receiving station is responsible for re-sequencing and determining if packets are lost. IP handles congestion by simple discarding packets. Re-sequencing and error handling are taken care of by upper layer protocols.

IP works on a number of local and wide area networks. When IP runs in the LAN environment on an Ethernet network, for example, the data field in the Ethernet frame holds the IP packet and a specific field in the frame indicates that IP information is enclosed. IP uses an addressing scheme that works independently of the network addressing scheme. For example, every Ethernet adapter has a factory-assigned address for each node.

IP Addressing

Every node on an IP network requires a 4-byte numeric address that identifies both a network and a local host or node on the network. This address is written as four numbers separated by dots, for example, 148.1.9.1. In most cases, the network administrator sets up these addresses when installing a device.

The assignment of addresses is arbitrary within a company or organization, but if a company plans to connect with the Internet any time in the near future, a registered addresses should be obtained from the Defense Data Network (DDN) Network Information Center (NIC), which is managed by Network Solutions in Chantilly, Virginia. With the growing popularity of the Internet, it is recommended that all organizations obtain registered addresses to avoid address conflicts in the future.

There are three classes of Internet addresses; Class A, B and C. Class A networks use the first byte of the IP address for the network number and the remaining three bytes for the host number. The first byte may have any value from one to 127.

Class B networks use the first two bytes of the IP address for the network number and the last two bytes for the host number. The first byte must have a value from 128 to 191.

Class C networks use the first three bytes of the IP address for the network number and the last byte for the host number. This scheme provides for a very large number of different networks, each with up to 255 addressable devices. The first byte must have a value from 192 to 223.

The part of the IP address that refers to the network is called the network address. A network mask is the bit pattern which yields the network address in a Boolean AND operation with the IP address. For example, in Class C networks, network addresses take the form X.X.X.0. The network mask for Class C networks is 255.255.255.0. In all of the IP addresses on a given network, the network address will remain the same while the host portion will be different for each host or workstation.

Appendix D - Disabling the Internal DSU

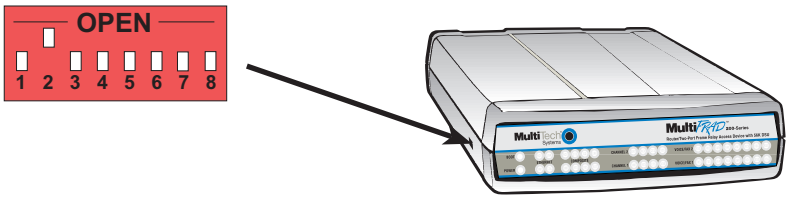
Perform the following procedure if your WAN network has been upgraded to T1/E1 and you now want to *disable* the MultiFRAD's internal DSU and use the back panel Trunk connection to obtain data rates of up to 2.048 Mbps.

1 Turn off the MultiFRAD using the back panel Power switch.

2 Locate the access window (side slot opening) near the left front corner of the MultiFRAD.

3 Using a small flat blade screwdriver or similar tool, press *down* on DIP Switch 2 (Figure D-1) until it is even with all the other DIP switches; the internal DSU is now disabled.

DIP switch 2 UP; internal DSU is enabled.



DIP switch 2 DOWN; internal DSU is disabled.

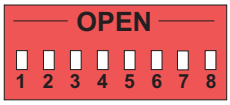


Figure D-1. DIP Switch 2 Location and Functions

4 If your trunk connection is V.35 rather than the default RS232C, refer to **V.35 Shunt Procedure** in **Chapter 2 - Installation** and move the **Trunk** shunt to the V.35 socket.

5 Disconnect the RJ-45 cable from the DSU jack and connect a trunk cable (Appendix A) to the DB25 female TRUNK connector on the back panel of the MultiFRAD.

6 Reapply power to the MultiFRAD, then configure the Trunk port as the WAN connection.

MultiFRAD™ 200-Series

Router/Two-Port Frame Relay Access Device with 56K DSU

Glossary

MultiTech® Systems

A

Access: The T1 line element made up of two pairs of wire that the telephone company brings to the customer premises. The Access portion ends with a connection at the local telco (LEC or RBOC).

Accunet Spectrum of Digital Services (ASDS): The AT&T 56K bps leased (private) line service. Similar to services of MCI and Sprint. ASDS is available in *n*x56/64K bps, where *n*=1, 2, 4, 6, 8, 12.

ACK (ACKnowledgement code) (pronounced "ack"): A communications code sent from a receiving modem to a transmitting modem to indicate that it is ready to accept data. It is also used to acknowledge the error-free receipt of transmitted data. Contrast with NAK.

Adaptive Differential Pulse Code Modulation (ADPCM): In multimedia applications, a technique in which pulse code modulation samples are compressed before they are stored on a disk. ADCPM, an extension of the PCM format, is a standard encoding format for storing audio information in a digital format. It reduced storage requirements by storing differences between successive digital samples rather than full values.

Address: A numbered location inside a computer. It's how the computer accesses its resources, like a video card, serial ports, memory, etc.

AMI line coding: One of two common methods of T1 line coding (with B8ZS). AMI line coding places restrictions on user data (B8ZS does not).

Analog signal: A waveform which has amplitude, frequency and phase, and which takes on a range of values between its maximum and minimum points.

Analog Transmission: One of two types of telecommunications which uses an analog signal as a carrier of voice, data, video, etc. An analog signal becomes a carrier when it is modulated by altering its phase, amplitude and frequency to correspond with the source signal. Compare with digital transmission.

Application Program Interface (API): A software module created to enable dissimilar, or incompatible applications programs to transfer information over a communications link. APIs may be simple or complex; they are commonly required to link PC applications with mainframe programs.

ASCII (American Standard Code for Information Interchange) (pronounced "askey"): A binary code for data that is used in communications and in many computers and terminals. The code is used to represent numbers, letters, punctuation and control characters. The basic ASCII code is a 7-bit character set which defines 128 possible characters. The extended ASCII file provides 255 characters.

Asynchronous Transfer Mode (ATM): A very high-speed method of transmission that uses fixed-size cells of 53 bytes to transfer information over fiber; also known as cell relay.

AT Commands: A standard set of commands used to configure various modem parameters, establish connections and disconnect. The "AT" is used to get the "attention" of the modem before the actual command is issued.

Availability: The measure of the time during which a circuit is ready for use; the complement of circuit "outage" (100% minus % outage = % available).

B

B7ZS (Bipolar 7 Zero Suppression) line coding: One method of T1 line coding (see also "B8ZS" and "AMI"). B7ZS line coding does not place restrictions on user data (AMI does).

B8ZS (Bipolar 8 Zero Suppression) line coding: One of two common methods of T1 line coding (with AMI). B8ZS line coding does not place restrictions on user data (AMI does). A coding method used to produce 64K bps "clear" transmission. (See also "B7ZS" and "AMI" line coding)

Backbone: 1. A set of nodes and their interconnecting links providing the primary data path across a network. 2. In a local area network multiple-bridge ring configuration, a high-speed link to which the rings are connected by means of bridges. A backbone may be configured as a bus or as a ring. 3. In a wide area network, a high-speed link to which nodes or data switching exchanges (DSEs) are connected. 4. A common distribution core that provides all electrical power, gases, chemicals, and other services to the sectors of an automated wager processing system.

Background: An activity that takes place in the PC while you are running another application. In other words, the active user interface does not correspond to the 'background' task.

Bandwidth: The transmission capacity of a computer channel, communications line or bus. It is expressed in cycles per second (hertz), the bandwidth being the difference between the lowest and highest frequencies transmitted. The range of usable frequencies that a transmission medium will pass without unacceptable attenuation or distortion. Bandwidth is a factor in determining the amount of information and the speed at which a medium can transmit data or other information.

Backward Explicit Congestion Notification (BECN): A bit that tells you that a certain frame on a particular logical connection has encountered heavy traffic. The bit provides notification that congestion-avoidance procedures should be initiated in the opposite direction of the received frame. See also FECN (Forward Explicit Congestion Notification).

Basic Rate Interface (BRI): An ISDN access interface type comprised of two B-channels each at 64K bps and one D-channel at 64K bps (2B+D).

Bell Operating Companies (BOC): The family of corporations created during the divestiture of AT&T. BOCs are independent companies which service a specific region of the US. Also called Regional Bell Operating Companies (RBOCs).

Bell Pub 41450: The Bell publication defining requirements for data format conversion, line conditioning, and termination for direct DDS connection.

Bell Pub 62310: The Bell publication defining requirements for data format conversion, line conditioning, and termination for direct DDS connection.

Binary Synchronous Communication (BSC): A form of telecommunication line control that uses a standard set of transmission control characters and control character sequences, for binary synchronous transmission of binary-coded data between stations.

Bit (Binary digIT): A bit is the basis of the binary number system. It can take the value of 1 or 0. Bits are generally recognized as the electrical charge generated or stored by a computer that represent some portion of usable information.

Bit Error Rate Test (BERT): A device or routine that measures the quality of data transmission. A known bit pattern is transmitted, and the errors received are counted and a BER (bit error rate) is calculated. The BER is the ratio of received bits in error relative to the total number of bits received, expressed in a power of 10.

Bit robbing: The use of the least significant bit per channel in every sixth frame for signaling. The line signal bits "robbed" from the speech pat conveys sufficient pre-ISDN telephony signaling information with the remaining line signal bits providing sufficient line signaling bits for recreating the original sound. See "robbed bit signaling".

Blue Alarm: An error indication signal consisting of all 1s indicating disconnection or attached device failure. Contrast "Red Alarm" and "Yellow Alarm".

Bps (bits per second): A unit to measure the speed at which data bits can be transmitted or received. Bps differs from baud when more than one bit is represented by a single cycle of the carrier.

Bridges: 1. A functional unit that interconnects two local area networks that use the same logical link protocol but may use different medium access control protocols. 2. A functional unit that interconnects multiple LANs (locally or remotely) that use the same logical link control protocol but that can use different medium access control protocols. A bridge forwards a frame to another bridge based on the medium access control (MAC) address. 3. In the connection of local loops, channels, or rings, the equipment and techniques used to match circuits and to facilitate accurate data transmission.

Buffer: A temporary storage register or Random Access Memory (RAM) used in all aspects of data communications which prevents data from being lost due to differences in transmission speed. Keyboards, serial ports, muxes and printers are a few examples of the devices that contain buffers.

Bus: A common channel between hardware devices either internally between components in a computer, or externally between stations in a communications network.

Byte: The unit of information a computer can handle at one time. The most common understanding is that a byte consists of 8 binary digits (bits), because that's what computers can handle. A byte holds the equivalent of a single character (such as the letter A).

C

Call Setup Time: The time to establish a circuit-switched call between two points. Includes dialing, wait time, and CO/long distance service movement time.

Carrier Group Alarm (CGA): A T1 service alarm generated by a channel bank when an OOF condition occurs for a predefined length of time (usually 300 mS to 2.5 seconds). The CGA causes the calls using a trunk to be dropped and for trunk conditioning to be applied.

Carrier signal: An analog signal with known frequency, amplitude and phase characteristics used as a transport facility for useful information. By knowing the original characteristics, a receiver can interpret any changes as modulations, and thereby recover the information.

CCITT (Consultative Committee for International Telephone and Telegraph): An advisory committee created and controlled by the United Nations and headquartered in Geneva whose purpose is to develop and to publish recommendations for worldwide standardization of telecommunications devices. CCITT has developed modem standards that are adapted primarily by PTT (post, telephone and telegraph) organizations that operate telephone networks of countries outside of the U.S. See also ITU.

Central Office (CO): The lowest, or most basic level of switching in the PSTN (public switched telephone network). A business PABX or any residential telephone connects to the PSTN at a central office.

Centrex: A multi-line service offered by operating telcos which provides, from the telco CO, functions and features comparable to those of a PBX for large business users. See also "Private Branch Exchange", "Exchange".

Channel: A data communications path between two computer devices. Can refer to a physical medium (e.g., UTP or coax), or to a specific carrier frequency.

Channel bank: A device that acts as a converter, taking the digital signal from the T1 line into a phone system and converting it to the analog signals used by the phone system. A channel bank acts as a multiplexer, placing many slow-speed voice or data transactions on a single high-speed link.

Circuit-switched Network: A technology used by the PSTN that allocates a pair of conductors for the exclusive use of one communication path. Circuit switching enables multiple conversations on one talk path only if the end-users multiplex the signals prior to transmission.

Circuit switching: The temporary connection of two or more communications channels using a fixed, non-shareable path through the network. Users have full use of the circuit until the connection is terminated.

Clear Channel: A transmission path where the full bandwidth is used (i.e., no bandwidth needed for signaling, carrier framing or control bits). A 64K bps digital circuit usually has 8K bps used for signaling. ISDN has two 64K bps circuits, and a 16K bps packet service of which part is used for signaling on the 64K channels.

Client-Server: In TCP/IP, the model of interaction in distributed data processing in which a program at one site sends a request to a program at another site and awaits a response. The requesting program is called a client; the answering program is called a server.

Cluster Controller: A device that can control the input/output operations of more than one device connected to it. A cluster controller may be controlled by a program stored and executed in the unit, or it may be entirely controlled by hardware.

Committed Burst Size: the maximum number of bits that the frame relay network agrees to transfer during any measurement interval

Committed Information Rate (CIR): An agreement a customer makes to use a certain minimum data transmission rate (in bps). The CIR is part of the frame relay service monthly billing, along with actual usage, that users pay to their frame relay service provider.

Compression: 1. The process of eliminating gaps, empty fields, redundancies, and unnecessary data to shorten the length of records or blocks. 2. In SNA, the replacement of a string of up to 64 repeated characters by an encoded control byte to reduce the length of the data stream to the LU-LU session partner. The encoded control byte is followed by the character that was repeated (unless that character is the prime compression character). 3. In Data Facility Hierarchical Storage Manager, the process of moving data instead of allocated space during migration and recall in order to release unused space. 4. Contrast with decompression.

COMx Port: A serial communications port on a PC.

Congestion: A network condition where there is too much data traffic. The ITU I.233 standard defines congestion management in terms of speed and burstiness.

Congestion notification: The function in frame relay that ensures that user data transmitted at a rate higher than the CIR are allowed to slow down to the rate of the available network bandwidth.

Consecutive Severely Errored Seconds (CSES): An error condition that occurs when from 3 to 9 SES (Severely Errored Seconds) are logged consecutively.

Customer Premises Equipment (CPE): The generic term for data comm and/or terminal equipment that resides at the user site and is owned by the user with the following exclusions: Over-voltage protection equipment, inside wiring, coin-operated or pay telephones, "company-official" equipment, mobile telephone equipment, "911" equipment, equipment necessary for the provision of communications for national defense, or multiplexing equipment used to deliver multiple channels to the customer.

D

D4: the T1 4th generation channel bank.

D4 channelization: Refers to the compliance with AT&T TR 62411 for DS1 frame layout.

D4 framing: The T1 format for framing in AT&T D-Series channel banks, in which there are 12 separate 193-bit frames in a superframe. A D4 framing bit is used to identify the channel and the signaling frame. Signalling for voice channels is carried in-band for every channel, along with the encoded voice. See "robbed-bit signaling".

Data Communications Equipment (DCE): Any device which serves as the portal of entry from the user equipment to a telecommunications facility. A modem is a DCE for the telephone network (PSTN) that is commonly on site at the user's premises. Packet Switched Networks have another level of DCE which is most often located at a central office.

Data Link Connection Identifier (DLCI): One of the six components of a frame relay frame. Its purpose is to distinguish separate virtual circuits across each access connection. Data coming into a frame relay node is thus allowed to be sent across the interface to the specified "address". The DLCI is confirmed and relayed to its destination, or if the specification is in error, the frame is discarded.

Dataphone Digital Service (DDS): A private line digital service that offers 2400, 4800, 9600 and 56K bps data rates on an inter-LATA basis by AT&T and on an intra-LATA basis by the BOCs.

Data Service Unit (DSU): A device that provides a digital data service interface directly to the data terminal equipment. The DSU provides loop equalization, remote and local testing capabilities, and a standard EIA/CCITT interface.

Dedicated Line: A communication line that is not switched. The term leased line is more common.

Default: This is a preset value or option in software packages, or in hardware configuration, that is used unless you specify otherwise.

Device driver: Software that controls how a computer communicates with a device, such as a printer or mouse.

Digital Cross-connect System (DCS): The CO device which splits and redistributes the T1 bandwidth. The DCS takes time slots from various T1 lines and alters them to provide the needed connectivity. DCS connections are made with software at an administrator's workstation.

Digital Data: Information represented by discrete values or conditions (contrast "Analog Data").

Digital Loopback: A technique used for testing the circuitry of a communications device. Can be initiated locally, or remotely (via a telecommunications device). The tested device decodes and encodes a received test message, then echoes the message back. The results are compared with the original message to determine if corruption occurred en route.

Digital PBX: A Private Branch Exchange that operates internally on digital signals. See also "Exchange".

Digital Service, level 0 (DS0): The worldwide standard speed (64K bps) for digital voice conversation using PCM (pulse coded modulation).

Digital Service, level 1 (DS1): The 1.544M bps voice standard (derived from an older Bell System standard) for digitized voice transmission in North America. The 1.544M bps consists of 24 digitally-encoded 64K bps voice channels (north America) and 2.048M bps (30 channels) elsewhere.

Digital Signal: A discrete or discontinuous signal (e.g., a sequence of voltage pulses). Digital devices, such as terminals and computers, transmit data as a series of electrical pulses which have discrete jumps rather than gradual changes.

Digital Signaling Rates (DSn): A hierarchical system for transmission rates, where "DS0" is 64K bps (equivalent to ISDN B channel), and DS1 is 1.5 Mbps (equivalent to ISDN PRI).

Digital Transmission: A method of electronic information transmission common between computers and other digital devices. Analog signals are waveforms: a combination of many possible voltages. A computer's digital signal may be only "high" or "low" at any given time. Therefore, digital signals may be "cleaned up" (noise and distortion removed) and amplified during transmission.

Digitize: To convert an analog signal to a digital signal.

DIP switch (pronounced "dip switch"): A set of tiny toggle switches, built into a DIP (dual in-line package), used for setting configurable parameters on a PCB (printed circuit board).

Driver: A software module that interfaces between the Operating System and a specific hardware device (i.e. color monitors, printers, hard disks, etc.). Also known as a device driver.

Drop and Insert: The process where a portion of information carried in a transmission system is demodulated ("Dropped") at an intermediate point and different information is included ("Inserted") for subsequent transmission.

DTE (Data Terminating Equipment): A term used to include any device in a network which generates, stores or displays user information. DTE is a telecommunications term which usually refers to PCs, terminals, printers, etc.

DTMF (Dual-Tone MultiFrequency): A generic push-button concept made popular by AT&T TouchTone.

E

E&M: A telephony trunking system used for either switch-to-switch, or switch-to-network, or computer/telephone system-to-switch connection.

EIA: The Electronics Industries Association is a trade organization in Washington, DC that sets standard for use of its member companies. (See RS-232, RS-422, RS530.)

Encapsulation: A technique used by network-layer protocols in which a layer adds header information to the protocol data unit from the preceding layer. Also used in "enveloping" one protocol inside another for transmission. For example, IP inside IPX.

Errored Seconds (ES): Any second of operation that all 1.544M bits are not received exactly as transmitted. Contrast "Error Free Seconds".

Error Free Seconds (EFS): Any second of operation that all 1.544M bits are received exactly as transmitted. Contrast "Errored Seconds".

ESF Error Event: A T1 error condition that is logged when a CRC-6 error or an OOF error occurs.

Ethernet: A 10-megabit baseband local area network that enables multiple stations to access the transmission medium at will without prior coordination, avoids contention by using carrier sense and deference, and resolves contention by using collision detection and transmission. Ethernet uses carrier sense multiple access with collision detection (CSMA/CD).

Excess Zeros: A T1 error condition that is logged when more than 15 consecutive 0s or less than one 1 bit in 16 bits occurs.

Exchange: A unit (public or private) that can consist of one or more central offices established to serve a specified area. An exchange typically has a single rate of charges (tariffs) that has previously been approved by a regulatory group.

Exchange Area: A geographical area with a single uniform set of charges (tariffs), approved by a regulatory group, for telephone services. Calls between any two points within an exchange area are local calls. See also "Digital PBX", "PBX".

Exchange Termination (ET): The carrier's local exchange switch. Contrast with "Loop Termination - LT".

Explicit Congestion Management: The method used in frame relay to notify the terminal equipment that the network is overly busy. The use of FECN and BECN is called explicit congestion management. Some end-to-end protocols use FECN or BECN, but usually not both options together. With this method, a congestion condition is identified and fixed before it becomes critical. Contrast with "implicit congestion".

Extended Super Frame (ESF): One of two popular formats for framing bits on a T1 line. ESF framing has a 24-frame super-frame, where robbed bit signaling is inserted in the LSB (bit 8 of the DS-0 byte) of frames 6, 12, 18 and 24. ESF has more T1 error measurement capabilities than D4 framing. ESF and B8ZS are typically both offered to provide clear channel service.

F

Failed Seconds: A test parameter where the circuit is unavailable for one full second.

Failed Signal: A T1 test parameter logged when there are more than 9 SES (Severely Errored Seconds).

Fax (facsimile): Refers to the bit-mapped rendition of a graphics-oriented document (fax) or to the electronic transmission of the image over telephone lines (faxing). Fax transmission differs from data transmission in that the former is a bit-mapped approximation of a graphical document and, therefore, cannot be accurately interpreted according to any character code.

Firmware: A category of memory chips that hold their content without electrical power, they include ROM, PROM, EPROM and EEPROM technologies. Firmware becomes "hard software" when holding program code.

Foreground: The application program currently running on and in control of the PC screen and keyboard. The area of the screen that occupies the active window. Compare with "background".

Fractional T1 (FT1): A digital data transmission rate between 56 Kbps (DS0 rate) and 1.544 Mbps (the full T1 rate - in North America). FT1 is typically provided on 4-wire (two copper pairs) UTP. Often used for video conferencing, imaging and LAN interconnection due to its low cost and relatively high speed. FT1 rates are offered in 64 Kbps multiples, usually up to 768 Kbps.

Frequency: A characteristic of an electrical or electronic signal which describes the periodic recurrence of cycles. Frequency is inversely proportional to the wavelength or pulse width of the signal (i.e., long wavelength signals have low frequencies and short wavelength signals yield high frequencies).

Foreign Exchange (FX): A CO trunk with access to a distant CO, enabling ease of access and flat-rate calls anywhere in the foreign exchange area.

Foreign Exchange Office (FXO): provides local telephone service from a CO outside of ("foreign" to) the subscriber's exchange area. In simple form, a user can pick up the phone in one city and receive a tone in the foreign city.

Connecting a POTS telephone to a computer telephony system via a T1 link requires a channel bank configured for the FX connection. To generate a call from the POTS set to the computer telephony system, a FXO connection must be configured.

Foreign Exchange Station (FXS): See FX, FXO. To generate a call from the computer telephony system to the POTS set, a FXS connection must be configured.

Forward Explicit Congestion Notification (FECN): A bit that tells you that a certain frame on a particular logical connection has encountered heavy traffic. The bit provides notification that congestion-avoidance procedures should be initiated in the same direction of the received frame. See also BECN (Backward Explicit Congestion Notification).

Frame: A group of data bits in a specific format to help network equipment recognize what the bits mean and how to process them. The bits are sent serially, with a flag at each end signifying the start and end of the frame.

Frame Relay: A form of packet switching that uses small packets and that requires less error checking than other forms of packet switching. Frame relay is effective for sending "bursty" data at high speeds (56/64K, 256K, and 1024 Kbps) over wide area networks. Frame Relay specifications are defined by ANSI documents ANSI T1.602, T1.606, T1S1/90-175, T1S1/90-213, and T1S1/90-214. In using frame relay, blocks of information (frames) are passed across a digital network interface using a "connection number" that is applied to each frame to distinguish between individual frames.

Frame Relay Forum: A nonprofit organization of 300+ vendors and service providers, based in Foster City, CA, that are developing and deploying frame relay equipment.

Frame Relay Implementors Forum: A group of companies supporting a common specification for frame relay connection to link customer premises equipment to telco network equipment. Their specification supports ANSI frame relay specs and defines extensions such as local management.

Frame Relay Access Device (FRAD): A piece of equipment that acts as a concentrator or frame assembler/dissassembler that can support multiple protocols and provide basic "routing" functions.

G

Gateway: 1. Afunctional unit that interconnects two computer networks with different network architectures. A gateway connects networks or systems of different architectures. A bridge interconnects networks or systems with the same or similar architectures. 2. A network that connects hosts.

Graphical User Interface (GUI): A type of computer interface consisting of a visual metaphor of a real-world scene, often of a desktop. Within that scene are icons, representing actual objects, that the user can access and manipulate with a pointing device.

H

Handshaking: A process that two modems go through at the time of call setup to establish synchronization over the data communications link. It is a synchronization and negotiation process accomplished by the exchange of predefined, mutually recognized control codes.

High-level Data Link Control (HDLC): An ISO standard, bit-oriented data communications protocol that provides nearly error-free data transfers.

I

Hexadecimal: A base 16 numbering system used to represent binary values. Hex uses the numbers 0-9 and the letters A-F: usually notated by an "h" (e.g., "4CF h", read "four charley fox, hex"). The result is that one hex digit represents a 4-bit value.

Implicit congestion management: A method of informing the terminal that the network is busy. This method relies on the end-system protocol to detect and fix the congestion problem. (TCP/IP is an example of a protocol using only implicit congestion management.) See also "explicit congestion management".

In-band: Refers to the type of signalling over the conversion path on an ISDN call. Contrast "out-of-band".

Insufficient Ones: A T1 error condition that is logged when less than one 1 in 16 0s or less than 12.5 % average 1s density is received.

Inter Exchange Carrier (IEC): The long distance company (LE) who's central office provides the point of reference for T1 access. Any common carrier authorized by the FCC to carry customer transmissions between LATAs.

Internet: Refers to the computer network of many millions of university, government and private users around the world. Each user has a unique Internet Address.

Internet Address (IP Address): A unique 32-bit address for a specific TCP/IP host on a network. Normally printed in dotted decimal format (e.g., 129.128.44.227).

Internet Protocol (IP): A protocol used to route data from its source to its destination in an Internet environment. The Internet Protocol was designed to connect to local area networks. Although there are many protocols that do this, IP refers to the global system of interconnecting computers. It is a highly distributed protocol (each machine only worries about sending data to the next step in the route).

Internetwork Packet Exchange (IPX): A NetWare communications protocol used to route messages from one node to another. IPX packets include network addresses and can be routed from one network to another. An IPX packet can occasionally get lost when crossing networks, thus IPX does not guarantee delivery of a complete message. Either the application has to provide that control, or NetWare's SPX protocol must be used.

Interoperable: Devices from different vendors that can exchange information using a standard's base protocol.

I/O Addresses: Locations within the I/O address space of your computer used by a device, such as an expansion card, a serial port, or an internal modem. The address is used for communication between software and a device.

IRQ Level (Interrupt Request Level): The notification a processor receives when another portion of the computer's hardware requires its attention. IRQs are numbered so that the device issuing the IRQ can be identified, and so IRQs can be prioritized.

ISA (Industry Standards Architecture) (pronounced "ice a"): The classic 8 or 16-bit architecture introduced with IBM's PC-AT computer.

ISDN (Integrated Services Digital Network): An International telecommunications standard for transmitting voice, video and data over a digital communications line. ISDN is a world-wide telecommunications service that uses digital transmission and switching technology to support voice and digital data communications. Frame relay was partially based on ISDN's data link layer protocol (LAPD). Frame relay can be used to transmit across ISDN services offering circuit-switched connection at 64K bps and higher speeds. Contrast Public Switched Telephone Network (PSTN).

ITU-TSS (formerly CCITT): International Telecommunications Union-Telecommunications Sector; the United Nations organization that prepares standards ("Recommendations") for resolving communications issues and problems.

K

Key Telephone System (KTS): Phone devices with multiple buttons that let you select incoming or outgoing CO phone lines directly. Similar in operation to a PBX, except a KTS you don't have to dial a "9" for a call outside the building.

Key Service Unit (KSU): A small device containing the switching electronics for a business key telephone system (KTS).

Key Set: A telephone set with several buttons for call holding, line pickup, intercom, autodialing, etc. Also called a touch tone phone (Ericsson) and a KTS (Key Telephone Set).

L

LAPB: Link Access Procedure Balanced; based on the X.25 Layer 2 specification. A full-duplex point-to-point bit-synchronous protocol commonly used as a data link control protocol to interface X.25 DTEs. LAPB is the link initialization procedure that establishes and maintains communications between the DTE and the DCE.

LAPD: Link Access Protocol for the D-Channel; based on the ISDN Q.921 specification. A full-duplex point-to-point bit-synchronous link-level protocol for ISDN connections; different from LAPB in its framing sequence. Transmission is in units called "frames", and a frame may contain one or more X.25 packets.

Line Coding: The representation of 1s and 0s on a T1 line. The two methods of line coding commonly used, B8ZS and AMI, differ in the restrictions placed on user data. T1 line coding ensures that sufficient timing information is sent with the digital signal to ensure recovery of all the bits at the far end. Timing information on the T1 line is included in the form of 1s in the data stream; a long string of 0s in the data stream could cause problems recovering the data.

Line Termination (LT): The electronics at the ISDN network side of the user/network interface that complements the NT1 at the user side. The LT and the NT1 together provide the high-speed digital line signals required for BRI access.

Listed Directory Number (LDN): The main number assigned by the telco; the number listed in the telephone directory and also provided by Directory Assistance. Some devices can have more than one LDN, such as ISDN devices that have one LDN for voice and another LDN for data.

Local Area Network (LAN): 1. A computer network located on a user's premises within a limited geographical area. Communication within a local area network is not subject to external regulations; however, communication across the LAN boundary may be subject to some form of regulation. 2. A LAN does not use store and forward techniques. 3. A network in which a set of devices are connected to one another for a communication and that can be connected to a larger network.

Local Access and Transport Area (LATA): A post-divestiture geographical area generally equivalent to a Standard Metropolitan Statistical Area. At divestiture, the territory served by the Bell system was divided into approximately 161 LATAs. The Bell Operating Companies (BOCs) provide Intra-LATA services.

Local Exchange Carrier (LEC): The local phone company which provides local (i.e., not long distance) transmission services. aka "telco". LECs provide T1 or FT1 access to LDCs (unless the T1 circuit is completely intra-LATA). Inter-LATA T1 circuits are made up of a combination of Access and Long Haul facilities.

Local Management Interface (LMI): A specification for frame relay equipment that defines status information exchange.

Local Loop: A transmission path, typically twisted-pair wire, between an individual subscriber and the nearest public telecommunications network switching center. The wires provide ISDN service, but require an NT1 at the user end and an LT at the network end. (aka, "loop" or "subscriber loop".)

Logical Link Control (LLC2): In a local area network, the protocol that governs the exchange of transmission frames between data stations independently of how the transmission medium is shared. The LLC2 protocol was developed by the IEEE 802 commitee and is common to all LAN standards.

Logical Unit (LU): A type of network accessible unit that enables end users to gain access to network resources and communicate with each other.

Long Haul: The T1 element that connects to the Access portion of the long distance company's (LDC's) central office. The LDC is commonly called the point of presence (POP). Each LDC has a number of POPs, located throughout the country. The LDC is also called an IEC (Inter Exchange Carrier).

Long Haul Communications: The type of phone call reaching outside of a local exchange (LE).

M

Management Information Base (MIB): A database of network management information used by the Common Management Information Protocol (CMIP) and the Simple Network Management Protocol (SNMP).

Megacom: An AT&T service with a normal WATS line (typically T1) between the customer premise and the AT&T serving class 4 CO are the customer's responsibility.

MegaLink: BellSouth's leased T1 service.

Message: Associated with such terms as packet, frame, and segment. 1. In information theory, an ordered series of characters intended to convey information. 2. An assembly of characters and sometimes control codes that is transferred as an entry from an originator to one or more recipients.

Modem: A communications device that enables a computer to transmit information over a telephone line. It converts the computer's digital signals into analog signals to send over a telephone line and converts them back to digital signals at the receiving end. Modems can be internal and fit into an expansion slot, or external and connect to a serial port.

Multiplexer (Mux): 1. A device that takes several input signals and combines them into a single output signal in such a manner that each of the input signals can be recovered. 2. A device capable of interleaving the events of two or more activities or capable of distributing the events of an interleaved sequence to the respective activities. 3. Putting multiple signals on a single channel.

Multiprotocol: A device that can interoperate with devices utilizing different network protocols.

Multithreading: The ability of a software system to be able to handle more than one transaction concurrently. This is contrasted to the case where a single transaction is accepted and completely processed before the next transaction processing is started.

N

Nailed Connection: A permanent or dedicated circuit of a previously switched circuit or circuits.

Nailed-up Circuit: A semipermanent circuit established through a circuit-switching facility for point-to-point connectivity.

NAK (Negative Acknowledgment): Communications code used to indicate that a message was not properly received, or that a terminal does not wish to transmit. Contrast with ACK.

Network: A group of computers connected by cables or other means and using software that enables them to share equipment, such as printers and disk drives to exchange information.

Node: Any point within a network which has been assigned an address.

O

Object-Orientated: A method for structuring programs as hierarchically organized classes describing the data and operations of objects that may interact with other objects.

Office Channel Unit - Data Port (OCU-DP): The CO channel bank used as the interface between the customer's DSU and the channel bank.

Off-hook: The condition of a device which has accessed a phone line (with or without using the line). In modem use, this is equivalent to a telephone handset being picked up. Dialing and transmission are allowed, but incoming calls are not answered. Contrast "on-hook".

Off Premise Extension (OPX): An extension or phone that terminates in a location other than that of the PBX. Commonly used to provide a corporate member with an extension of the PBX at home.

Ones Density: the measure of the number of logical 1s on a T1 line compared to a given total number of bits on that line; used for timing information in data recovery in AMI and B8ZS.

On-Hook: The condition of a device which has not accessed a phone line. In modem use, this is equivalent to a telephone handset that has not been picked up. In other words, it can receive an incoming call. Contrast "off-hook".

Open Shortest Path First (OSPF): A hierarchical Interior Gateway Protocol (IGP) routing algorithm for IP that is a proposed standard for Internet. OSPF incorporates least-cost routing, equal-cost routing, and load balancing.

Outage: The measure of the time during which a circuit is not available for use due to service interrupt. Outage is the complement of circuit "availability" (100% minus % available = % outage).

Out-of-band: Signaling that is separated from the channel carrying the information (i.e., the voice/data/video signal is separate from the carrier signal). Dialing and various other "supervisory" signals are included in the signaling element. Contrast "In-band" signaling.

Out of Frame (OOF): A T1 alarm condition that is logged on the loss of 2, 3 or 4 of 5 consecutive FT framing bits.

P

Packet: 1. In data communication, a sequence of binary digits, including data and control signals, that is transmitted and switched as a composite whole. The data, control signals and, possibly, error control information are arranged in a specific format. 2. Synonymous with data frame. 3. In TCP/IP, the unit of data passed across the interface between the Internet layer and the link layer. A packet includes an IP header and data. A packet can be a complete IP datagram or a fragment of an IP diagram. 4. In X.25, a data transmission information unit. A group of data and control characters, transferred as a unit, determined by the process of transmission. Commonly used data field lengths in packets are 128 or 256 bytes. 5. The field structure and format defined in the CCITT X.25 recommendation.

Packet Assembler/Dissembler (PAD): Used by devices to communicate over X.25 networks by building or stripping X.25 information on or from a packet.

Packet Data: The information format ("packetized") used for packet-mode calls.

Packet Mode: Refers to the switching of chunks of information for different users using statistical multiplexing to send them over the same transmission facility.

Parity bit: An extra bit attached to each byte of synchronous data used to detect errors in transmission.

Permanent Virtual Circuit (PVC): A connection between two endpoints dedicated to a single user. IN ISDN, PVCs are established by network administration and are held for as long as the user subscribes to the service.

Physical Unit (PU): The component that manages and monitors the resources (such as attached links and adjacent link stations) associated with a node, as requested by an SSCP via an SSCP-PU session. An SSCP activates a session with the physical unit in order to indirectly manage, through the PU, resources of the node such as attached links. This term applies to type 2.0, type 4, and type 5 nodes only.

Point of Presence (POP): The central office's end points of the long distance carriers.

Point to Point Protocol (PPP): A protocol that lets a PC user access TCP/IP (Internet member) using an ISDN terminal adapter or a high-speed modem over a standard telephone line.

Port: A location for input or output data exchange. Computers, muxes, etc. have ports for various purposes.

Primary Rate Interface (PRI): Used on ISDN. In North America, and Japan, PRI is one 64 Kbps D channel and 23 B channels. Elsewhere, it is one D channel and 30 B channels.

Primitive: An abstract representation of interaction across the access points indicating that information is being passed between the service user and the service provider. The OSI Reference Model defines four types of primitives: Request, Indication, Response and Confirm.

Private Branch Exchange (PBX): A telephone exchange located on the customer's premises. The PBX provides a circuit switching facility for telephone extension lines within the building, and access to the public telephone network. See also "Exchange".

PROM (Programmable Read Only Memory - pronounced "prom"): A permanent memory chip that can be programmed or filled by the customer after by the manufacturer has set initial values. Contrast with ROM.

Protocol: 1. A set of semantic and syntactic rules that determines the behavior of functional units in achieving communication. 2. In Open Systems Interconnection architecture, a set of semantic and syntactic rules that determine the behavior of entities in the same layer in performing communication functions. 3. In SNA, the meanings of and the sequencing rules for requests and responses used for managing the network, transferring data, and synchronizing the states of network components. 4. Synonymous with line control discipline.

PSTN (Public Switched Telephone Network): A worldwide public voice telephone network that is used as a telecommunications medium for the transmission of voice, data and other information.

Public Data Network (PDN): A packet-switched network that is available to the public for individual ("subscriber") use. Typically, controlled by a government or a national monopoly.

Public Switched Telephone Network (PSTN): The group of circuit-switching voice carriers, which are commonly used as analog data communications services.

Pulse Code Modulation (PCM): 1. In data communication, variation of a digital signal to represent information; for example, by means of pulse amplitude modulation (PAM), pulse duration modulation (PDM), or pulse position modulation (PPM). 2. Transmissions of analog information in digital form through sampling and encoding the samples with a fixed number of bits.

Pulse dialing: One of two methods of dialing a telephone, usually associated with rotary-dial phones. Compare with "tone dialing".

Q

Quantizing: The process of analog-to- digital conversion by assigning a range, from the contiguous analog values, to a discrete number.

R

Random Access Memory (RAM): A computer's primary workspace. All data must be stored in RAM (even for a short while), before software can use the processor to manipulate the data. Before a PC can do anything useful it must move programs from disk to RAM. When you turn it off, all information in RAM is lost.

Rate Enforcement: The concept in frame relay where frames sent faster than the CIR are to be carried only if the bandwidth is available, otherwise they are to be discarded. (The frame relay network assumes that anything exceeding the CIR is of low priority.) Rate enforcement makes sure that the network will not get so congested that it isn't able to meet the agreed on CIR

Recognized Private Operating Agency (RPOA): A corporation, private or government-controlled, that provides telecommunications services. RPOAs, such as AT&T, participate as non-voting members in the CCITT.

Red Alarm: A T1 error condition generated when a local failure (e.g., loss of synchronization) exists for 2.5 seconds, causing a Carrier Group Alarm (CGA). See also "Blue Alarm" and "Yellow Alarm".

Request for Comment (RFC): A set of papers in which Internet standards (published and proposed), along with generally-accepted ideas, proposals, research results, etc. are published.

Ring Down Box: A device that emulates a CO by generating POTS calls for testing and product demos.

Ring Down Circuit: A tie line connecting phones where picking up one phone automatically rings another phone. A feature used for emergencies to alert the person at the other phone of the incoming call.

RJ-11: An industry standard interface used for connecting a telephone to a modular wall outlet; comes in 4- and 6-wire packages.

RJ-45: An 8-wire modular connector for voice and data circuits.

Robbed Bit Signaling: The popular T1 signaling mechanism where the A and B bits are sent by each side of the T1 termination and are "buried" in the voice data of each voice channel in the T1 circuit. Since the bits are "robbed" infrequently, voice quality is remains relatively uncompromised. See "bit robbing".

The robbed-bit signaling technique is used in D4 channel banks to convey signaling information. The eighth (least significant) bit of each of the 24 8-bit time slots is "robbed" every sixth frame to convey voice-related signaling information such as on-hook, off-hook, etc., for each channel.

Router: A device that connects two networks using the same networking protocol. It operates at the Network Layer (Layer 3) of the OSI model for forwarding decisions.

Routing Information Protocol (RIP): A distance vector-based protocol that provides a measure of distance, or hops, from a transmitting workstation to a receiving workstation.

RS232-C: An EIA standard for a serial interface between computers and peripheral devices (modem, mouse, etc.). It uses a 25-pin DB-25, or a 9-pin DB-9 connector. The RS-232 standard defines the purposes, electrical characteristics and timing of the signals for each of the 25 lines.

RS-422: The EIA standard for a balanced interface with no accompanying physical connector. RS-422 products can use screw terminals, DB-9, various DB-25, and DB-37 connectors.

RS-530: The EIA standard for the mechanical/electrical interface between DCEs and DTEs transmitting synchronous or asynchronous serial binary data. RS-530 provides for high data rates with the same connector used for RS-232; however, it is incompatible with RS-232.

S

Serial Port: The connector on a PC used to attach serial devices (those that need to receive data one bit after another), such as a mouse, a printer or a modem. This consists of a 9- or 25-pin connector that sends data in sequence (bit by bit). Serial ports are referred to as "COMx" ports, where x is 1 to 4 (i.e., COM1 through COM4). A serial port contains a conversion chip called a "UART" which translates between internal parallel and external serial formats.

Service: The requirements offered by an RPOA to its customers to satisfy specific telecommunications needs.

Severely Errored Seconds (SES): Refers to a typical T1 error event where an error burst occurs (a short term, high bit-error rate that is self-clearing). Per the ITU-T (CCITT) G.821: any second in which the BER is less than $1x10^{-3}$.

Signaling: The process of establishing, maintaining, accounting for, and terminating a connection between two endpoints (e.g., the user premises and the telco CO). Central office signals to the user premises can include ringing, dial tone, speech signals, etc. Signals from the user's telephone can include off-hook, dialing, speech to far-end party, and on-hook signals.

In-band signaling techniques include pulse and tone dialing. With common channel signaling, information is carried out-of-band.

Simple Network Management Protocol (SNMP): TCP/IP protocol that allows network management.

Simultaneous Voice Data (SVD): A technology for letting a user send data via a modem, and use a handset to talk to another user at the same time over the same connection. The alternative, making a second call, can be expensive or even impossible. The uses for SVD are telecommuting, videoconferencing, distant learning, tech support, etc.

Stop Bit: One of the variables used for timing in asynchronous data transmission. Depending on the devices, each character may be trailed by 1, 1.5, or 2 stop bits.

Superframe (D4): A T1 transmission format that consists of 12 DS1 frames, or 2316 bits. A DS1 frame consists of 193 bit positions. A frame overhead bit is in the first position, and it is used for frame and signaling phase alignment only.

Subscriber Loop: See "Local loop".

Switched 56: A circuit-switched (full duplex digital synchronous data transmission) service that lets you dial a number and transmit data to it at 56K bps. It is a relatively low cost service, widely used in North America for telecommuting, videoconferencing and high speed data transfers. Many phone companies are (or will be) phasing out Switched 56 in favor of ISDN service.

Switched Virtual Circuit (SVC): A type of data transmission where the connection is maintained only until the call is cleared.

Switched Line: In communications, a physical channel established by dynamically connecting one or more discreet segments. This connection lasts for the duration of the call after which each segment may be used as part of a different channel. Contrast with leased line.

Switched Network: A network in which a temporary connection is established from one point via one or more segments.

Synchronous Data Link Control (SDLC): A discipline conforming to subsets of the Advanced Data Communications Control Procedures (ADCCP) of the American National Standards Institute (ANSI) and High-level Data Link Control (HDLC) of the International Organization for Standardization, for managing synchronous, code-transparent, serial-by-bit information transfer over a link connection. Transmission exchanges may be duplex, or half-duplex over switched or non-switched links. The configuration of the link connection may be point-to-point, multipoint, or loop.

Synchronous Transmission: The transmission of data which involves sending a group of characters in a packet. This is a common method of transmission between computers on a network or between modems. One or more synchronous characters are transmitted to confirm clocking before each packet of data is transmitted. Compare to Asynchronous Transmission.

Systems Network Architecture (SNA): The description of the logical structure, formats, protocols, and operational sequences for transmitting information units through, and controlling the configuration and operation of networks.

T

Tariff: The rate/availability schedule for telephone and ISDN services from a regulated service provider.

TCP/IP: A set of communication protocols that support peer-to-peer connectivity functions for both local and wide area networks.

T Carrier: The generic name for a digitally multiplexed carrier system. In the North American digital hierarchy, a T is used to designate a DS (digital signal) level hierarchy. Examples: T1 (DS1) is a 1.544 M bps 24-channel designation. In Europe, T1 is called E1. The T Carrier system was originally designed for transmitting digitized voice signals, but has since been adapted for digital data applications.

T1: A digital transmission link capable of 1.544M bps. T1 uses two pairs of normal UTP, and can handle 24 voice conversations, each digitized at 64K bps. T1 is a standard for digital transmission in the U.S., Canada, Japan and Hong Kong. T1 is the access method for high-speed services such as ATM, frame relay, and SMDS. See also T Carrier, T1 line and FT1.

T1 Channel Tests: A set of diagnostics that vary by carrier, used to verify a T1 channel operation. Can include Tone, Noise Level, Impulse Noise Level, Echo Cancellors, Gain, and Crosstalk testing.

T1 Framing: To digitize and encode analog voice signals requires 8000 samples per second (twice the highest voice frequency of 4000 Hz). Encoding in an 8-bit word provides the basic T1 block of 64K bps for voice transmission. This "Level 0 Signal, as its called, is represented by "DS-0", or Digital Signal at Level 0. 24 of these voice channels are combined into a serial bit stream (using TDM), on a frame-by-frame basis. A frame is a sample of all 24 channels; so adding in a framing bit gives a block of 193 bits (24x8+1=193). Frames are transmitted at 8000 per second (the required sample rate), creating a 1.544M (8000x193=1.544M) transmission rate.

T1 Line: A digital communications facility that functions as a 24-channel pathway for data or voice. A T1 line is composed of two separate elements: the Access element and the Long Haul element.

T1 Mux: A device used to carry many sources of data on a T1 line. The T1 mux assigns each data source to distinct DS0 time slots within the T1 signal. Wide bandwidth signals take more than one time slot. Normal voice traffic or 56/64K bps data channels take one time slot. The T1 mux may use an internal or external T1 DSU; a "channel bank" device typically uses an external T1 CSU.

Transmission Control Protocol / Internet Program (TCP/IP): A multilayer set of protocols developed by the US Department of Defense to link dissimilar computers across dissimilar and unreliable LANs.

Terminal: The screen and keyboard device used in a mainframe environment for interactive data entry. Terminals have no "box", which is to say they have no file storage or processing capabilities.

Terminal Adapter (TA): An ISDN DTE device for connecting a non-ISDN terminal device to the ISDN network. Similar to a protocol converter or an interface converter, a TA connects a non-ISDN device between the R and S interfaces. Typically a PC card.

Tie line: A dedicated circuit linking two points without having to dial a phone number (i.e., the line may be accessed by lifting the telephone handset or by pushing a button).

Time-Division Multiplexing (TDM): Division of a transmission facility into two or more channels by allotting the common channel to several different information channels, one at a time.

Time Slot: One of 24 channels within a T1 line. Each channel has a 64K bps maximum bandwidth. "Time slot" implies the time division multiplexing organization of the T1 signal.

Toll Call: A call to a location outside of your local service area (i.e., a long distance call).

Tone dialing: One of two methods of dialing a telephone, usually associated with Touch Tone® (push button) phones. Compare with pulse dialing.

Topology: Physical layout of network components (cables, stations, gateways, and hubs). Three basic interconnection topologies are star, ring, and bus networks.

Transmission Control Protocol (TCP): A communications protocol used in Internet and in any network that follows the US Department of Defense standards for internetwork protocol. TCP provides a reliable host-to-host protocol between hosts in packet-switched communications networks and in interconnected systems of such networks. It assumes that the Internet protocol is the underlying protocol.

Transport Layer: Layer 4 of the Open Systems Interconnection (OSI) model; provides reliable, end-to-end delivery of data, and detects transmission sequential errors.

Transport Protocol Data Unit (TPDU): A transport header, which is added to every message, contains destination and source addressing information that enables the end-to-end routing of messages in multi-layer NAC networks of high complexity. They are automatically added to messages as they enter the network and can be stripped off before being passed to the host or another device that does not support TPDU's.

Trunk: Transmission links that interconnect switching offices.

TSR (terminate and stay resident): A software program that remains active and in memory after its user interface is closed. Similar to a daemon in UNIX environments.

Tunneling: Encapsulation data in an IP packet for transport across the Internet.

Twisted pair wiring: A type of cabling with one or more pairs of insulated wires wrapped around each other. An inexpensive wiring method used for LAN and telephone applications, also called UTP wiring.

U

UART (Universal Asynchronous Receiver/Transmitter) (pronounced "you art"): A chip that transmits and receives data on the serial port. It converts bytes into serial bits for transmission, and vice versa, and generates and strips the start and stop bits appended to each character.

UNIX: An operating system developed by Bell Laboratories that features multiprogramming in a multi-user environment.

Unshielded Twisted Pair (UTP): Telephone-type wiring. Transmission media for 10Base-T.

V

V.25bis: An ITU-T standard for synchronous communications between a mainframe or host and a modem using HDLC or other character-oriented protocol.

V.54: The ITU-T standard for local and remote loopback tests in modems, DCEs and DTEs. The four basic tests are:

- local digital loopback (tests DTE send and receive circuits),
- local analog loopback (tests local modem operation),
- remote analog loopback (tests comm link to the remote modem), and
- remote digital loopback (tests remote modem operation).

Virtual Circuit: A logical connection. Used in packet switching wherein a logical connection is established between two devices at the start of transmission. All information packets follow the same route and arrive in sequence (but do not necessarily carry a complete address).

W

Wide Area Network (WAN): 1. A network that provides communication services to a geographic area larger than that served by a local area network or a metropolitan area network, and that may use or provide public communication facilities. 2. A data communications network designed to serve an area of hundreds or thousands of miles; for example, public and private packet-switching networks, and national telephone networks. Contrast with local area network (LAN).

Wide Area Telecommunications Service (WATS): A low-cost toll service offered by most long distance and local phone companies. Incoming (800 call service, or IN-WATS) and outgoing WATS are subscribed to separately, but over the same line.

X

X.25: ITU-T's definition of a three-level packet-switching protocol to be used between packet-mode DTEs and network DCEs. X.25 corresponds with layer 3 of the 7-layer OSI model.

Y

Yellow Alarm: An error indication sent by the T1 device when it has not gotten a receive signal, or cannot synchronize on the receive signal received. Contrast "Red Alarm" and "Blue Alarm".

Z

Zero Byte Time Slot Interchange (ZBTSI): A method for enabling 64K bps unrestricted user data (enabling all 0s in the user data). An alternative to (but not as popular as) 8BZS.

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